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ABSTRACT

These supplementary units are designed to help students with special needs learn and apply auto body repair skills. The material specifically supplements the Auto Body Repair Curriculum Guide (University of Missouri-Columbia 1988), and is intended for instructors serving the occupational needs of various categories of disadvantaged and handicapped students. The instructor key contains notes to the instructor, helpful resources, the Missouri auto body employability competencies matrix for the nine units, a rating sheet, class progress chart, and answer keys for the unit tests. Units contain illustrated step-by-step instructions for the specific auto body repair competencies they address. Each of the nine self-paced and self-contained units contains large print, simplified text, and numerous line drawings to aid in comprehension. Each unit consists of: an introduction; objectives study questions; student assessment; terms and equipment; steps of procedure; skill sheets; activity sheets; and a unit test and performance checklist. Topics covered in the nine units are the following: safety; jacking and lifting; welding; body fillers; surface preparation; sanding; primers and guidecoats; masking; and diagnosing and analyzing damage. (KC)

ED325710

SUPPLEMENTARY UNITS

AUTO BODY REPAIR

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August 1990

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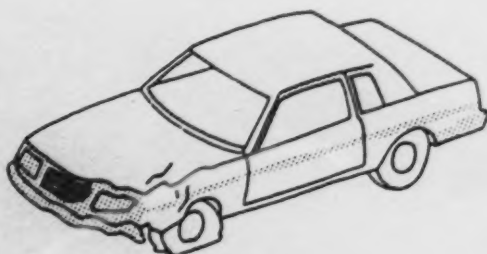
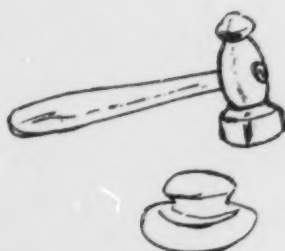
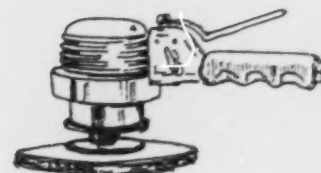
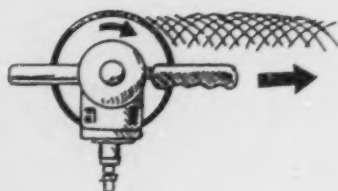
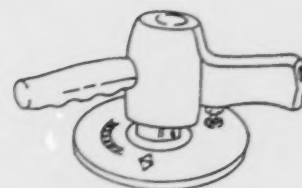
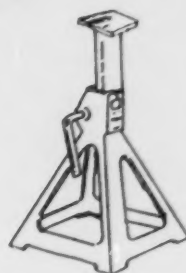
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SUPPLEMENTARY UNITS

90-6200-K

AUTO BODY REPAIR

INSTRUCTOR KEY



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

SUPPLEMENTARY UNITS, AUTO BODY REPAIR

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SUPPLEMENTARY UNITS, AUTO BODY REPAIR

PREFACE

These supplementary units are designed to help students with special needs learn and apply auto body repair skills. The material specifically supplements Auto Body Repair Curriculum Guide, University of Missouri-Columbia, 1988.

The guide is intended for instructors serving the occupational needs of various categories of disadvantaged and handicapped students and can be adapted to serve a wide range of instruction within those categories.

Students will find illustrated, step-by-step instructions for the specific auto body repair competencies these units address. Each of the nine self-paced and self-contained units contains large print, simplified text and numerous line-drawings to aid in comprehension.

Each unit within this curriculum is color coded to represent a separate section. Color coding is explained as follows:

- White: Introduction, Objectives, Study Questions and Student Assessment. This page presents unit and specific objectives the student must meet to complete the unit successfully. The introduction contains a brief motivational statement describing the purpose and content of unit. Student Assessment allows the student to determine whether to study the material in the unit or move directly to the unit test.
- Salmon: Terms and Equipment. This section introduces new terms and equipment necessary for the student to understand and perform the tasks shown in the unit.
- Canary: Steps of Procedure. These pages present a verbal and illustrated step-by-step explanation of a given skill or task.
- Green: Skill Sheets. These pages provide paper and pencil exercises to develop and reinforce the skills presented in the unit.
- Blue: Activity Sheets. Various activities are presented to increase

student involvement and provide extra practice in performing the procedures.

Pink: Unit Test and Performance Checklist. These pages are used by the instructor to evaluate student performance. Different forms of review, including identification, matching, multiple-choice and short-answer exercises are provided.

"Instructor's information," located at the front of the book, contains notes to the instructor, helpful resources and answer keys.

Remember that this curriculum was developed as a source and guideline for the instructor. Each instructor will use it differently, adapting the material to suit given teaching/learning situations.

SUPPLEMENTARY UNITS, AUTO BODY REPAIR

ACKNOWLEDGEMENTS

These supplementary units for Auto Body Repair represent the combined efforts of the following individuals:

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SUPPLEMENTARY UNITS, AUTO BODY REPAIR

GENERAL NOTES TO THE INSTRUCTOR

- Step 1:** Read through the information in each unit before presenting it to the student.
- Step 2:** Make sure all equipment to be used in each unit is available.
- Step 3:** Prepare any handouts, visuals or supplemental material to aid student learning activities.
- Step 4:** Provide student with the Introduction page.
- Step 5:** Discuss the Introduction and Objectives on the Introduction page and give directions for completing the "Are You Ready?" section.
- Step 6:** Have the student complete the "Are You Ready?" section.
- Step 7:** If the student elects to complete the Lesson Test and Performance Checklist and does so to your satisfaction, have him or her proceed to the next lesson.
- Step 8:** Discuss the Introduction page information with the student. At this time you can also discuss the Terms and Equipment lists.
- Step 9:** Provide the student with the Steps of Procedure section.
- Step 10:** Select a means to present the Steps of Procedure section.
- A. Have the student study the information independently.
 - B. Go through the information as a group.
 - C. Go through the material as a group; then have students work independently.
- Step 11:** Demonstrate the procedures to the student or class.
- Step 12:** Give the student time to practice the procedure. (You, the instructor, decide how much time students need.)

- Step 13:** Have the student complete all the Skill Sheets. Skill Sheets reinforce skills necessary to perform the procedures in the unit and may be used by the student as a self-evaluation tool or by the class as a discussion aid.
- Step 14** Complete Activity Sheets.
- Step 15:** When the student is ready, use the Unit Test and Performance Checklist to evaluate the student's performance for each unit.

SUPPLEMENTARY UNITS, AUTO BODY REPAIR

REFERENCES AND MATERIALS

References:

Crouse, William, and Anglin, Donald. **Automotive Body Repair and Refinishing**. Second edition. McGraw-Hill. New York, NY. 1986.

Duenk, Lester; Williams, Randolph; and Brooks, Clarence. **Auto Body Repair**. Second edition. Bennett Publishing Company. Peoria, IL. 1984.

Helms, Roger. **Auto Body Curriculum**. (Seven modules) Instructional Materials Laboratory, University of Missouri-Columbia. Columbia, MO. 1988.

Inter-Industry Conference on Auto Collision Repair. Unibody Auto Collision Repair Training Program. **Unibody Structural Sectioning and Use of Recycled Parts**. Inter-Industry Conference on Auto Collision Repair. Des Plaines, IL. 1984.

Rhone, L. C., and Yates, H. David. **Total Auto Body Repair**. Second edition, Bobbs-Merrill Educational Publishing. Indianapolis, IN. 1983.

Scharff, Robert. **Motor Auto Body Repair**. Delman Publisher, Inc. Albany, NY. 1988.

Toboldt, Bill. **Auto Body Repairing and Repainting**. The Goodheart-Willcox Co. Inc. South Holland, IL. 1982.

Audio-visual resources:

Auto Body Vocabulary Modules for Special Needs. Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, MO, 65211. Three units of terms to improve vocabulary comprehension of special needs students in metal forming, filling and painting. Approximately 100 terms, each explained in a four-picture sequence, six cassette tapes, 390 illustrations, instructor's guide, and one student work manual.

Supplementary Units

Auto Body

Supplementary Units - Auto Body

Missouri Auto Body Employability Competencies		UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	UNIT 6	UNIT 7	UNIT 8	UNIT 9
A2	Identify the basic construction of the auto body		X							
C5	Demonstrate proper lifting and jacking techniques		X							
D1	Identify government agencies regulating the auto body industry (OSHA) (EPA)	X								
D2	Identify general safety rules	X								
D3	Use protective clothing and equipment	X								
D4	Identify the proper use of fire protection equipment	X								
D5	Use chemicals safely	X								
E1	Diagnose and analyze damage									X
E2	Use collision manuals									X
E2	Write a damage report in logical sequence									X
F1	Identify auto body welding procedures			X						
F2	Use MIG welding safety procedures			X						
F3	Set up equipment for MIG welding			X						
F4	Prepare metal for MIG welding			X						
F10	Identify oxyacetylene welding safety procedures			X						
F11	Set up and use equipment for oxyacetylene welding			X						
F12	Set up and use equipment for oxyacetylene cutting			X						
F13	Use protective clothing and equipment			X						
G1	Analyze damage				X					
G2	Clean exterior surface				X	X				
G5	Prepare surface for body filler				X					
G6	Apply body filler				X					
G7	Finish body filler				X					
L1	Identify refinishing equipment							X		
L2	Use safe painting practices, including the use of protective clothing and equipment							X		
L3	Use the paint gun with proper technique							X		
M1	Identify surface preparation technique					X				
M3	Demonstrate appropriate masking techniques								X	
M4	Prepare surface of new panel					X				
M5	Prepare surface of damaged panel					X				
M6	Demonstrate appropriate sanding techniques						X			
M7	Select and apply appropriate primer/primer							X		
M8	Perform guide coat/block sanding/reprime							X		
X1	Identify vehicle frame construction		X							
X2	Identify frame and unibody terminology		X							

Special Needs Follow-Up Questionnaire

Staff members, writers and advisors have worked to make these instructional materials easy to use and read. We welcome your suggestions and/or corrections. Please return this questionnaire with your comments to:

Special Needs Editor
Instructional Materials Laboratory
8 London Hall
University of Missouri-Columbia
Columbia, Missouri 65211

SUPPLEMENTARY UNITS FOR AUTO BODY REPAIR

My overall rating of this publication is:

Excellent

Very Good

Good

Fair

Poor

To improve the materials, IML should:

Other Comments:

Optional:

Name: _____

Address: _____

Supplementary Units

Auto Body

Class Progress Chart

Student Name	WHAT THE STUDENT CAN DO
	Demonstrate safety practices and equipment in the auto body lab
	Demonstrate proper jacking and lifting techniques
	Use MIG welding techniques
	Use oxyacetylene welding and cutting techniques
	Apply and finish plastic body fillers
	Prepare the surface of a damaged panel
	Demonstrate correct power and hand sanding techniques
	Select and apply appropriate primers and guidecoats
	Demonstrate proper masking techniques
	Diagnose auto body damage and write a damage report

AUTO BODY
SAFETY

SAFETY

ANSWER KEY

SKILL SHEET 1

- | | |
|-------|-------|
| 1. B | 11. F |
| 2. A | 12. T |
| 3. B | 13. T |
| 4. T | 14. T |
| 5. F | 15. T |
| 6. F | 16. F |
| 7. T | 17. F |
| 8. T | 18. F |
| 9. T | 19. T |
| 10. T | 20. F |

SKILL SHEET 2

- | | |
|-------|-------|
| 1. F | 11. T |
| 2. F | |
| 3. T | |
| 4. F | |
| 5. F | |
| 6. F | |
| 7. F | |
| 8. T | |
| 9. F | |
| 10. T | |

SKILL SHEET 3

- | |
|-------|
| 1. D |
| 2. C |
| 3. A |
| 4. B |
| 5. F |
| 6. T |
| 7. F |
| 8. T |
| 9. T |
| 10. F |

SKILL SHEET 4

- | | |
|-------|-------|
| 1. T | 11. T |
| 2. F | 12. F |
| 3. T | 13. F |
| 4. F | 14. F |
| 5. T | 15. F |
| 6. T | |
| 7. T | |
| 8. T | |
| 9. T | |
| 10. T | |

UNIT TEST

- | | |
|-------|--------------------|
| 1. D | 13. Jewelry |
| 2. E | 14. Compressed air |
| 3. B | 15. Battery |
| 4. C | 16. Shoulder |
| 5. F | 17. Tight |
| 6. A | 18. Steel-toed |
| 7. A | 19. T |
| 8. E | 20. T |
| 9. F | 21. F |
| 10. C | 22. T |
| 11. B | 23. T |
| 12. D | 24. T |

AUTO BODY
LIFTING AND JACKING

LIFTING AND JACKING

ANSWER KEY

SKILL SHEET 1

- | |
|-------|
| 1. T |
| 2. F |
| 3. T |
| 4. F |
| 5. F |
| 6. T |
| 7. T |
| 8. F |
| 9. T |
| 10. F |

SKILL SHEET 2

- | |
|----------------------|
| 1. Pinch welds |
| 2. Torque boxes |
| 3. Unibody |
| 4. Conventional body |
| 5. Side rails |
| 6. Crossmembers |
| 7. F |
| 8. T |
| 9. F |
| 10. T |

UNIT TEST

- | | |
|-------------------------------|-------|
| 1. F | 13. F |
| 2. D | 14. T |
| 3. B | 15. F |
| 4. H | 16. T |
| 5. E | 17. F |
| 6. C | 18. F |
| 7. G | 19. T |
| 8. A | 20. T |
| 9. Floor jack | |
| 10. Bumper-type end lift jack | |
| 11. Safety stand | |

AUTO BODY
BODY FILLERS

AUTO BODY
WELDING

BODY FILLERS
ANSWER KEY

SKILL SHEET 1

- | | |
|------|-------|
| 1. F | 6. T |
| 2. T | 7. T |
| 3. T | 8. T |
| 4. F | 9. T |
| 5. F | 10. T |

SKILL SHEET 2

- | | |
|------|-------|
| 1. F | 6. T |
| 2. T | 7. F |
| 3. T | 8. T |
| 4. F | 9. T |
| 5. T | 10. F |

SKILL SHEET 3

- | | |
|------|-------|
| 1. C | 6. C |
| 2. C | 7. B |
| 3. A | 8. A |
| 4. B | 9. B |
| 5. C | 10. A |

SKILL SHEET 4

- | | |
|------|-------|
| 1. F | 6. F |
| 2. T | 7. F |
| 3. T | 8. F |
| 4. F | 9. F |
| 5. F | 10. F |

UNIT TEST

- | | | | | |
|------|------|-------|-------|-------|
| 1. D | 5. A | 9. B | 13. T | 17. T |
| 2. E | 6. G | 10. C | 14. F | 18. F |
| 3. B | 7. F | 11. T | 15. F | 19. F |
| 4. C | 8. C | 12. F | 16. T | 20. T |

WELDING
ANSWER KEY

SKILL SHEET 1

- | | | | |
|----------------|-------|-------|----------|
| 1. argon | 6. F | 11. T | 16. F |
| 2. transformer | 7. T | 12. F | 17. F |
| 3. flowmeter | 8. F | 13. T | 18. T |
| 4. regulator | 9. T | 14. F | 19. pull |
| 5. gun | 10. T | 15. T | 20. push |

SKILL SHEET 2

- | | | | |
|---------------|-------------------|-------|-------|
| 1. green | 6. cutting torch | 11. T | 16. F |
| 2. black | 7. needle valves | 12. T | 17. F |
| 3. oxygen | 8. pre-heat | 13. T | 18. F |
| 4. acetylene | 9. T-wrench | 14. F | 19. T |
| 5. regulators | 10. soapstone/awl | 15. F | 20. T |

UNIT TEST

- | | | | |
|------|-------|---------------------|---------------------------|
| 1. C | 8. A | 15. gun | 22. oxygen lever |
| 2. D | 9. F | 16. regulator | 23. oxygen pre-heat valve |
| 3. F | 10. G | 17. adjusting screw | 24. transformer |
| 4. E | 11. D | 18. flowmeter | 25. hood |
| 5. G | 12. C | 19. torch body | 26. sparklighters |
| 6. B | 13. E | 20. torch valves | 27. T-wrench |
| 7. A | 14. B | 21. cutting torch | |

AUTO BODY
SURFACE PREPARATION

AUTO BODY
PRIMERS AND GUIDECOATS

SURFACE PREPARATION

PRIMERS AND GUIDECOATS

ANSWER KEY

ANSWER KEY

SKILL SHEET 1

SKILL SHEET 2

SKILL SHEET 1

UNIT TEST

- | | | |
|-------|-------|-------|
| 1. D | 1. F | 11. F |
| 2. H | 2. T | 12. F |
| 3. A | 3. F | 13. T |
| 4. J | 4. F | 14. F |
| 5. B | 5. F | 15. F |
| 6. F | 6. F | |
| 7. I | 7. T | |
| 8. C | 8. F | |
| 9. G | 9. F | |
| 10. E | 10. F | |

1. T
2. T
3. F
4. F
5. T
6. T
7. D
8. D
9. B
10. C
11. D
12. A
13. A

- | | |
|-------|-------|
| 1. B | 21. T |
| 2. G | 22. T |
| 3. D | 23. F |
| 4. E | 24. F |
| 5. C | 25. T |
| 6. F | 26. F |
| 7. A | 27. F |
| 8. D | 28. D |
| 9. B | 29. D |
| 10. A | 30. C |
| 11. E | 31. D |

UNIT TEST

- | | | | | | |
|------|-------------------|---------------|-------|-------|-------|
| 1. E | 6. H | 11. Jitterbug | 16. B | 21. F | 26. F |
| 2. G | 7. A | 12. D.A. | 17. C | 22. F | 27. A |
| 3. D | 8. B | 13. D | 18. D | 23. T | 28. B |
| 4. C | 9. Grinder | 14. C | 19. F | 24. D | 29. E |
| 5. F | 10. Sanding block | 15. D | 20. T | 25. H | 30. G |
| | | | | | 31. C |

SKILL SHEET 2

1. T
2. F
3. T
4. F
5. T

15. Buffer
16. Spray gun
17. Paint strainer
18. Blow gun
19. Viscosity cap
20. Paint paddle

AUTO BODY
MASKING

MASKING
ANSWER KEY

SKILL SHEET 1

1. F
2. T
3. F
4. T
5. F
6. T
7. T
8. T
9. F
10. F
11. T
12. T
13. T
14. T
15. T
16. F
17. T
18. F
19. F
20. F

SKILL SHEET 2

- | | |
|------|------|
| 1. A | 4. C |
| 2. B | 5. D |
| 3. A | |

UNIT TEST

1. F
2. D
3. A
4. H
5. C
6. G
7. B
8. E
9. Wheel covers
10. Paper taper
11. Light covers
12. F
13. T
14. T
15. F
16. T
17. T
18. T
19. T
20. Cool
21. Hot
22. Fifteen
23. Molding
24. Bleed-through
25. Lacquer

AUTO BODY

DIAGNOSING AND ANALYZING DAMAGE

DIAGNOSING AND ANALYZING DAMAGE

ANSWER KEY

SKILL SHEET 1

- | | | |
|------|-------|-------|
| 1. 2 | 6. T | 11. F |
| 2. 4 | 7. F | 12. T |
| 3. 1 | 8. T | 13. T |
| 4. 5 | 9. F | 14. T |
| 5. 3 | 10. T | 15. T |

ACTIVITY SHEET 1:

Instructor's discretion.

ACTIVITY SHEET 2

1. 20495075-6, 20006553, 20206699
2. \$23.85, \$44.00, \$40.00
3. 14 hours, no time given, .3 hours

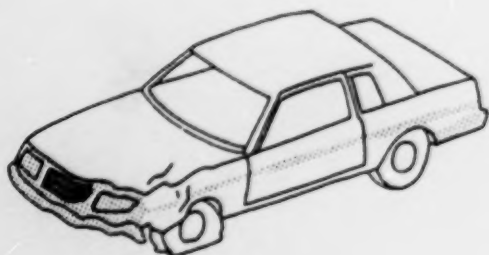
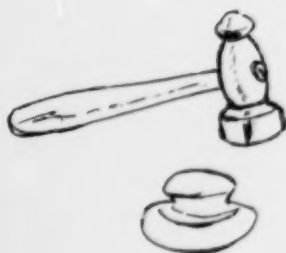
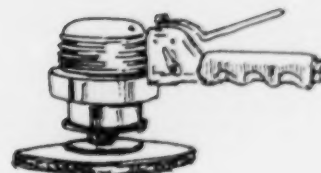
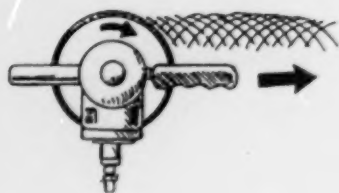
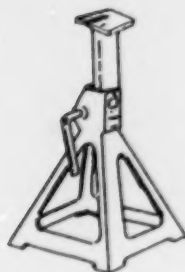
SKILL SHEET 2

- | | | |
|--------------|----------------|-----------------------|
| 1. 0 | 6. \$45 | 11. 1988 Ford Festiva |
| 2. 6 | 7. E8BZ16740A | 12. No |
| 3. .3 | 8. 5% | 13. \$414.46 |
| 4. \$21.45 | 9. \$324.46 | 14. \$3 |
| 5. Janet Zap | 10. Stan Sands | 15. No |

UNIT TEST

- | | |
|---------|--|
| 1. B | 11. 20173546-7 |
| 2. A | 12. Left fender, inner and outer panel |
| 3. D | 13. 3 |
| 4. C | 14. \$392.74 |
| 5. T | 15. \$150 |
| 6. T | 16. Face bar guard |
| 7. T | 17. 23,742.9 |
| 8. T | 18. No |
| 9. \$26 | 19. \$13.74 |
| 10. 2.5 | 20. Jack Johns |

SAFETY



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

SAFETY INTRODUCTION

Safety is the first and most important thing in the auto body shop. Unsafe practices can harm workers, employers, customers and the environment. It is your responsibility to protect yourself, the shop and those around you.

UNIT OBJECTIVE

After completing this unit, you should know more about the government agencies that enforce safety laws. You will also learn about safety rules.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Identify government agencies that regulate safety in the auto body industry.
2. Identify personal safety rules.
3. Identify auto body shop safety rules.
4. Demonstrate proper use of fire-protection equipment.
5. Identify chemical safety rules.

Put a check beside the statement that is true for you.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

A. TERMS

1. **Asbestos** - a fireproof material used in brakes and clutches.
2. **Carbon monoxide** - a poisonous gas you can't see or smell.
3. **Combustible** - capable of burning or catching fire.
4. **Contaminant** - a pollutant; a substance that, if allowed to mix with another substance, will make the second substance impure.
5. **Environmental Protection Agency (EPA)** - a federal agency that is responsible for keeping the environment safe.
6. **Flammable** - something that can be set on fire easily and that burns quickly.
7. **Flame retardant** - able to slow the production of fire.
8. **Lubrication** - the act of applying oil or grease so parts can move better.
9. **Occupational Safety and Health Administration (OSHA)** - a government agency responsible for keeping working conditions safe for employees.
10. **Toxic** - poisonous, acting as a poison.
11. **Vapors** - steam, smoke, gas or mist; anything that vanishes into the air.
12. **Ventilation** - the circulation of air within a building or room.

B. GOVERNMENT SAFETY REGULATION AGENCIES

Two government agencies control safety regulations in the auto body shop:

OSHA - Occupational Safety and Health Administration

EPA - Environmental Protection Agency

1. **OSHA** protects the health and lives of industry workers. OSHA creates guidelines or rules that every auto body shop must know and follow. Your school should have a copy of OSHA guidelines. Your instructor will review OSHA guidelines with you. The guidelines deal with:

- proper labeling of hazardous parts or equipment
- proper storage of equipment and material
- proper use of protective clothing and equipment
- proper placement of warning and safety signs in the shop
- proper safety practices

OSHA guidelines change as industry changes. When business develops and uses new machines and chemicals, OSHA establishes new rules to make sure the chemicals and materials are used safely.

2. The **EPA** makes rules that protect the worker and the environment. EPA rules concern materials that may be dangerous. For instance, the EPA says you must use air-supply respirators (1) when you work with paints that contain toxic materials or (2) when you weld materials that may release toxic gases. EPA rules also say you must properly handle, store and dispose of hazardous chemicals and materials.

EPA rules also change as industry changes. The school will have a current copy of EPA guidelines, and your instructor will review them with you. You must know and follow them.

To make sure employers, instructors, workers and students follow EPA and OSHA safety rules, EPA and OSHA inspectors visit companies and schools. Any companies or schools found not following the rules can be fined. **As a worker in the auto body shop, it is your responsibility to follow safety rules.**

C. PERSONAL SAFETY RULES

In the auto body shop, each piece of equipment has safety rules you must follow. As an auto body worker, you must think about (1) your personal safety, (2) the safety of the shop, (3) fire safety, and (4) chemical safety.

1. **Think about what you are doing.** Concentrate on the job. Work quietly so you do not interfere with another worker's concentration.
2. **Think ahead.** Before you begin a job, think about the safety that is involved. Take all safety precautions.
3. **No horseplay in the shop.** You could injure someone, or someone could injure you.



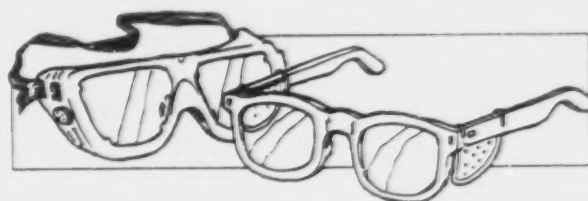
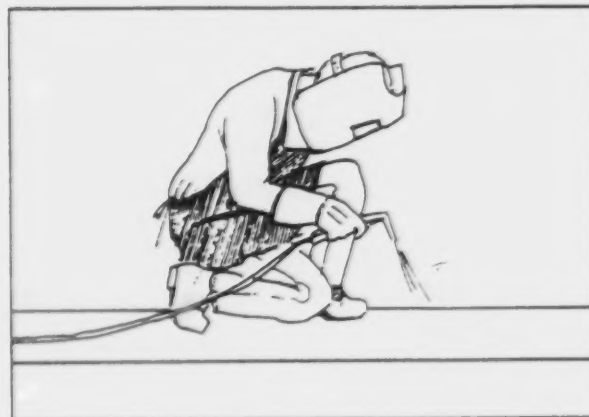
4. **Wear protective clothing and equipment when it is recommended.** Make a habit of wearing safety glasses, especially in situations where there are flying objects.

NOTE: Your school may require you to wear safety glasses any time you are in the shop.

Wear splash-resistant safety goggles in situations where paint or chemicals could touch your eyes. There are two kinds of safety goggles: (1) dust-and-impact resistant and (2) splash-resistant. Be sure to wear the proper kind for the situation.

CAUTION: Never wear safety glasses when safety goggles are required. Safety goggles seal the eyes from sprays and mists, but safety glasses do not.

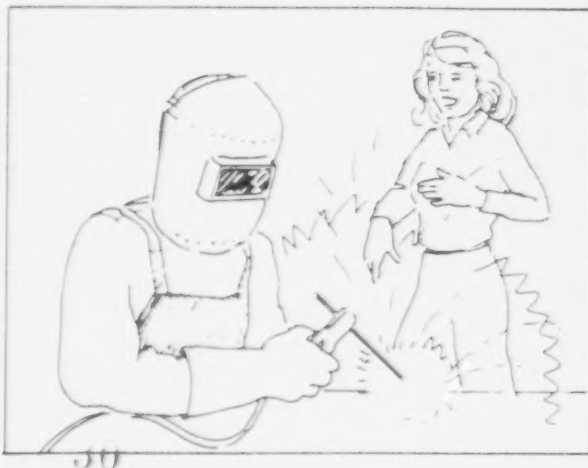
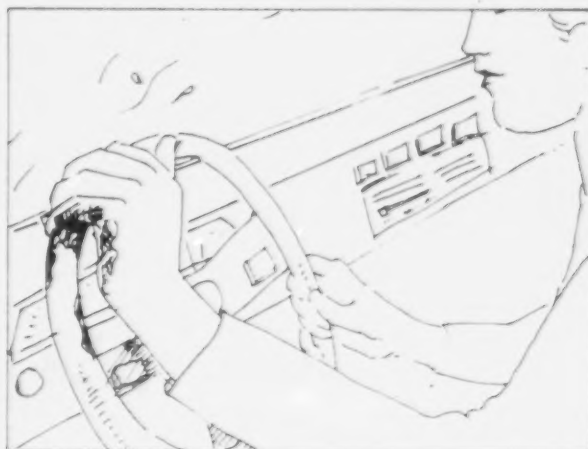
Wear a full face shield in situations where sharp flying objects could injure your face.



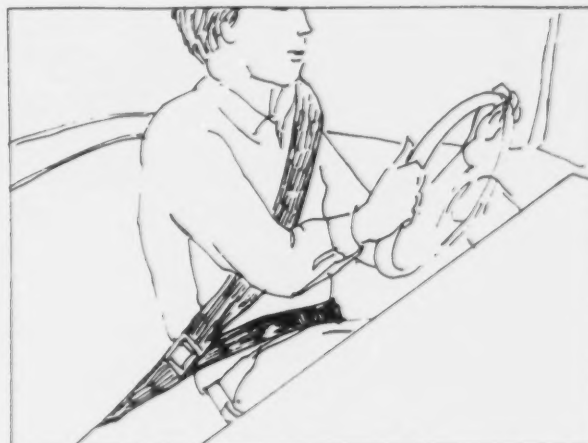
Wear breathing-protection gear when working with any materials or chemicals that could be dangerous if you breathed them.

NOTE: An auto body shop often uses such materials. They include many fillers and painting materials.

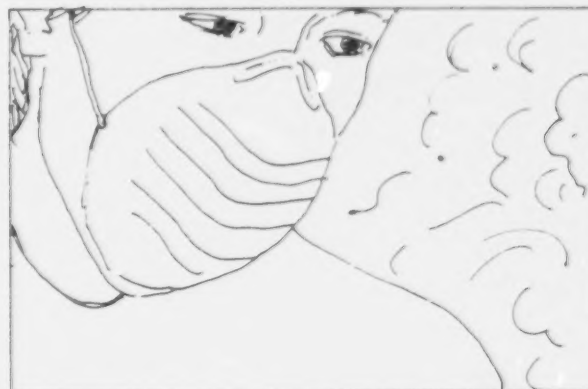
5. **Do not put sharp objects into your pockets.** They can stab you as your body shifts position. When you are working on the interior of a car, they can rip the seat cover.
6. **Keep your hands clean of oil and grease.** Oil and grease make handles slippery. They also ruin interior auto parts and primer-surfaces.
7. **Do not watch when someone is using an electric welder.** Sparks may fly on you, and watching for a long time can burn your eyes.



8. **Wear a seat belt when road-testing a vehicle. Do so even when you are only driving a short distance.** An accident can happen at any time, even when you are driving someone else's car and it isn't your fault.

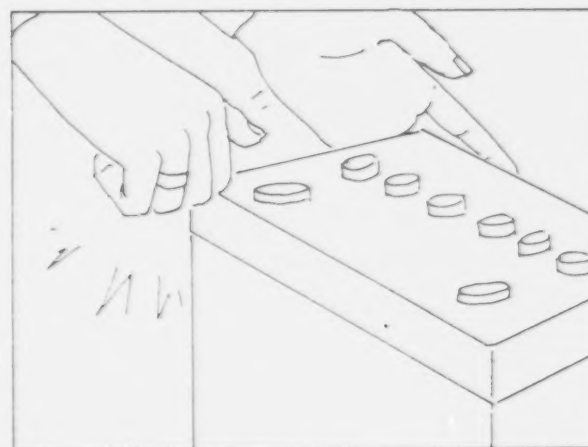


9. **When cleaning brake shoes or clutches, wear a particle mask. NEVER use compressed air for cleaning brake shoes or clutches.** Asbestos, which causes cancer, is found in brake shoes and clutches.

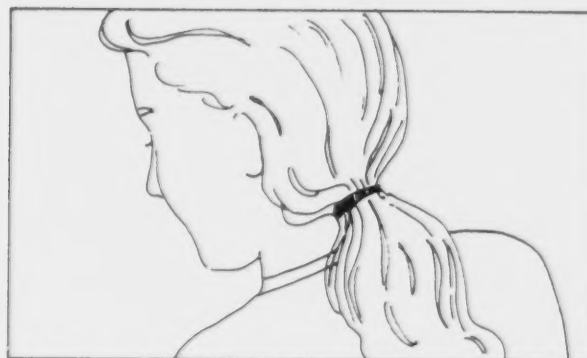


10. **Do not wear rings, watches, bracelets or necklaces when working around moving parts or electrical equipment.**

Jewelry can get caught in the moving parts of a machine and pull you in. A ring or bracelet can create a short circuit in a car battery. This reaction causes the metal in the jewelry to become white hot instantly. Serious burns can result.



11. **Long hair should be tied back and/or pinned up.** If allowed to hang loose, your hair can get tangled in moving parts.



12. **Never try to lift more than you can safely handle, and never lift in an area that has a wet or greasy floor.** When working in the body shop, you sometimes need to lift heavy objects. Unless you lift properly, you will hurt your back.

Avoid lifting whenever possible.

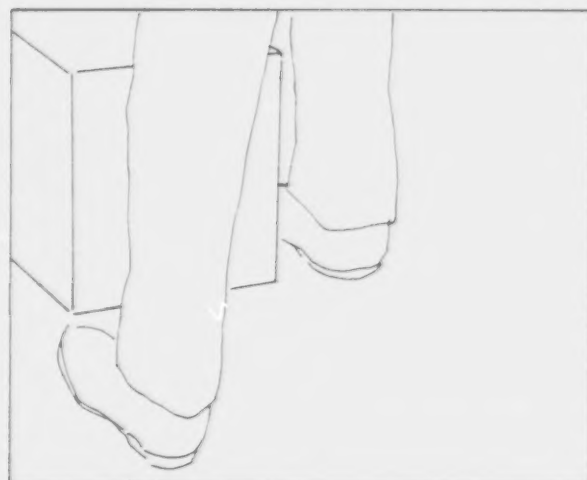
When something must be moved:

- (1) Push, pull, roll or slide it.
- (2) Use a hoist, jack, cart or wheeled truck.
- (3) Get help from another person.

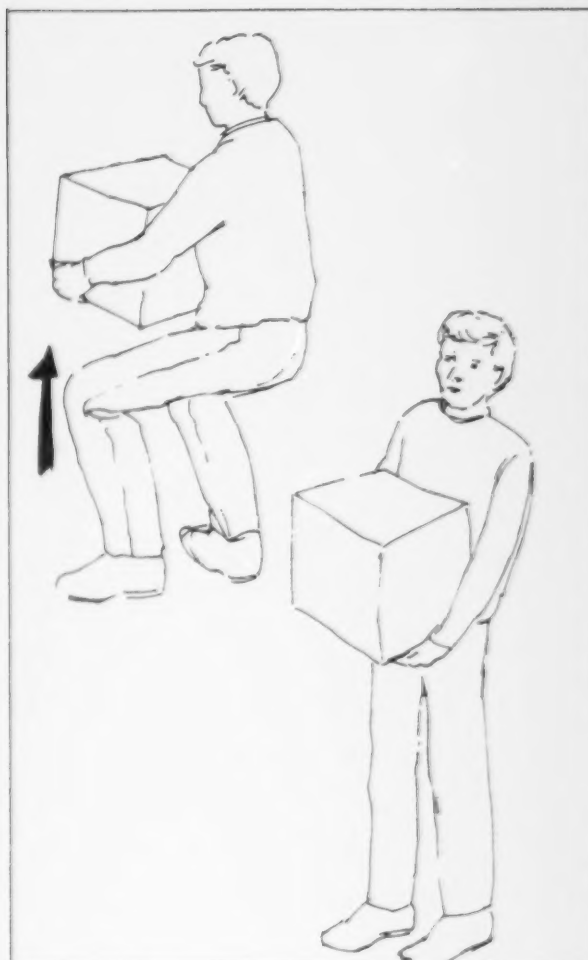


When you must lift something, use the following steps:

- A. Spread your feet slightly to a distance that is comfortable. Put one foot slightly ahead of the other and beside the object.



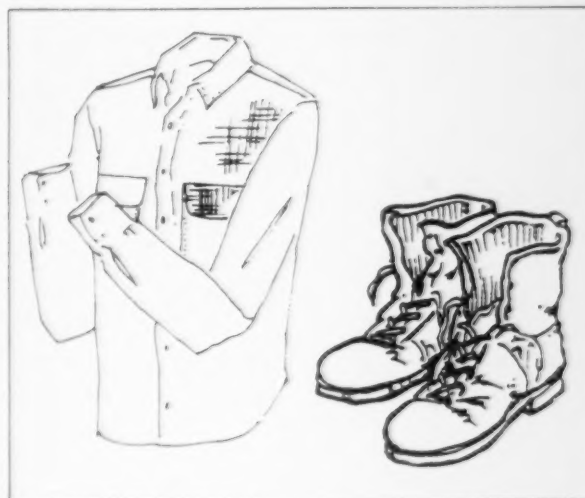
- B. Bend your knees, kneel or squat. **DO NOT BEND YOUR BACK!**
- C. Put blocks under the object to get a grip.
- D. Lift with your leg, arm and shoulder muscles. Straighten your legs as you come to a standing position.
- E. Shift your feet to turn. **DO NOT TWIST YOUR BODY AT THE WAIST.**
- F. Lower the load by bending your knees. Keep your back straight. Use your leg and arm muscles. Keep your fingers and toes clear of objects.



13. Always wear proper clothing.

Wear well-fitting, heavy clothes with close-fitting (buttoned up) cuffs. Shirt pockets should have a flap over the openings.

Wear leather shoes with non-skid soles. Wear steel-toed boots in situations that require them.



14. **Be careful when working around batteries.** Car batteries contain a mixture of acid and water. This solution is very dangerous. If it comes in contact with your eyes or skin, you will need immediate first aid.

If battery acid gets in your eye, begin to flush it with water at once. Continue washing your eye for at least 15 minutes. See a doctor quickly. If you can't see a doctor quickly, neutralize the acid with baking soda and water (2 tablespoons of baking soda in 2 cups of water). Keep flushing your eye.

If battery acid gets on your skin, remove the clothing from that area. Wash the area with plenty of soap and water for at least five minutes. See a doctor if blistering, burning or peeling occurs.



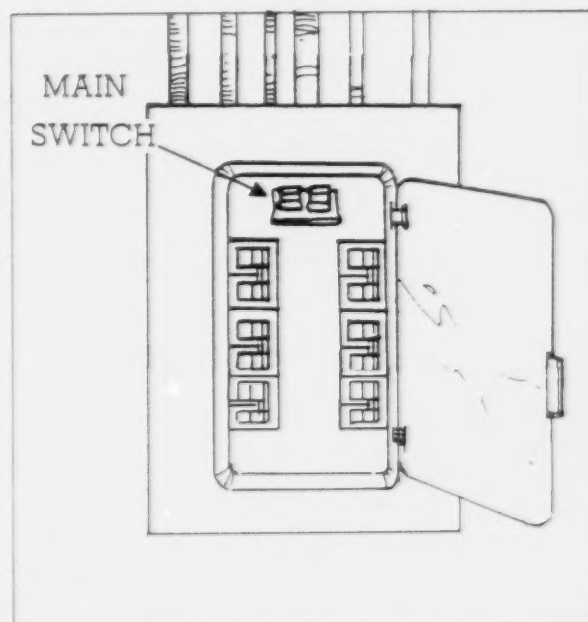
15. If an injury occurs, tell your teacher immediately. Even small injuries may need to be seen by a doctor. If you have had first aid training, begin emergency procedures at once. Never try to give first aid **UNLESS** you have had first aid training and know what you are doing.

NOTE: First-aid training means attending classes and passing tests. Watching a procedure on a video or television show does not make you competent enough to perform an emergency procedure.



16. Always shut electricity off before helping someone who has received an electrical shock.

You can be killed or injured even when helping someone who has come into contact with an electrical current. If the current is still on and the person is still in contact with it, **DO NOT** touch the person. Shut off the main circuit to the shop first. Touching the person will cause the current to pass through you too.



- [illegible]

36

SAFETY
SKILL SHEET 1

Directions: Circle the answer that best completes the sentence.

1. The purpose of safety rules is to protect the

- | | |
|----------------|-------------------------|
| a. government. | b. worker. |
| c. banks. | d. tools and equipment. |

2. Seat belts should be worn

- | | |
|--|--|
| a. anytime you test drive a vehicle. | b. only on test drives longer than one mile. |
| c. only when the belts are being tested. | d. none of the above. |

3. When cleaning brake and clutch parts, you should

- | | |
|------------------------|-----------------------------------|
| a. use compressed air. | b. <u>not</u> use compressed air. |
| c. use dry sand. | d. use a dirty rag. |

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

_____ 4. OSHA and EPA often change their guidelines.

_____ 5. A little horseplay makes the shop a safer place.

- _____ 6. It's safe to carry sharp objects in your pockets.
- _____ 7. When you work with asbestos, you should wear a breathing protector.
- _____ 8. You should not wear jewelry in the shop.
- _____ 9. Long hair can be unsafe in the shop.
- _____ 10. If an injury occurs in the shop, tell the instructor immediately.
- _____ 11. To perform first aid, you don't need training.
- _____ 12. If someone is receiving an electrical shock, you should first turn off the current and then grab and pull him or her away from the equipment.
- _____ 13. Don't lift heavy objects from wet or greasy floors.
- _____ 14. As you set a heavy object down, lower the load by bending your knees.
- _____ 15. If battery acid gets in your eyes, flush them with water for 15 minutes.
- _____ 16. Shop clothing should be loose-fitting for comfort.
- _____ 17. Tennis shoes are proper for shop work.
- _____ 18. Safety glasses are the same thing as safety goggles.
- _____ 19. Wear a face shield when working around sharp flying objects.
- _____ 20. You can wear sunglasses instead of safety glasses.

SAFETY

ACTIVITY SHEET 1

Directions: Your instructor will provide a heavy object. Move the object from one place to another safely.

D. SHOP SAFETY RULES

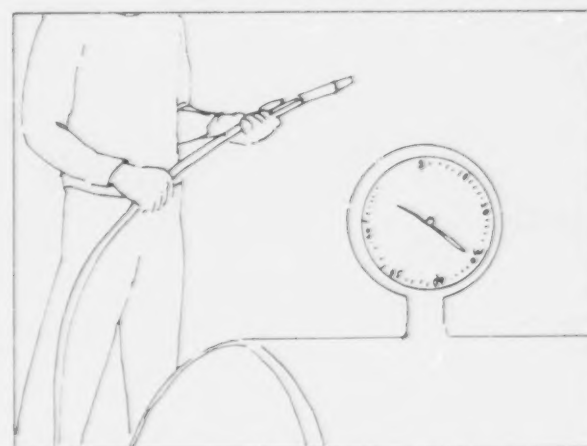
1. **Keep the floor clean and uncluttered.** Keep equipment out of the aisles. Store parts you will be using again on a bench. Store large parts against a wall.

Put waste material in containers. It can cause a fire.

Wipe up grease and other spills right away. If an oil spill cannot be wiped up, sprinkle an absorbing compound on it.

2. **Know where the exits are.** They should be well-marked and in plain view.

3. **Be careful with compressed air.** NEVER use compressed air to dry or blow dust from your clothing or skin. NEVER point a compressed air hose at another person. The air pressure can easily put out an eye. When you clean parts, the air pressure must not be more than 30 pounds per square inch (psi).



4. After cleaning up a flammable liquid with a rag, put the rag in a container approved for holding flammable rags.

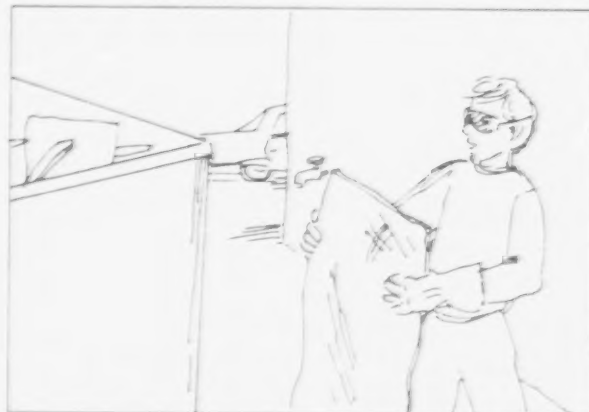


5. Be aware of possible safety hazards in the shop. Fix what you can and tell your instructor about possible hazards.

6. Whenever a vehicle is brought into the shop, disconnect its battery to prevent electrical shorts. ALWAYS carefully follow the manufacturer's instructions when disconnecting batteries. Some vehicle computer systems can be damaged if the battery is disconnected wrong.



7. When you remove torn and damaged sheet metal from a vehicle, dispose of it properly. DO NOT leave it on the floor. Someone may trip over it or get cut by it.



8. **Do not let objects fall into the fan of a running engine.** When working around the fan motor of a transverse-mounted engine, disconnect the current-supply wire to the motor. These fan motors can turn on even when the engine is off.

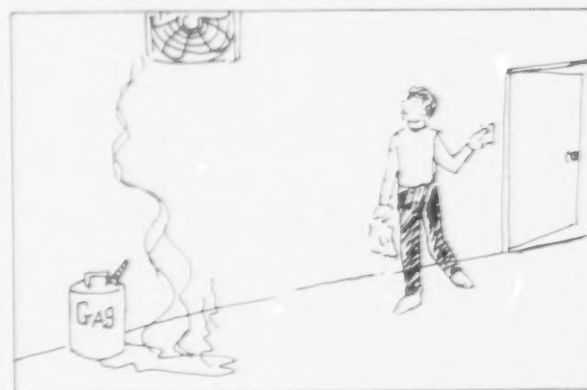


9. **Never place your bare hand over the outlet nozzles of spray equipment when spraying.**

10. **When you work with gasoline in a closed place, avoid sparks or open flames.** Gasoline vapors can cause an explosion. Even a spark from a light switch can set off an explosion.

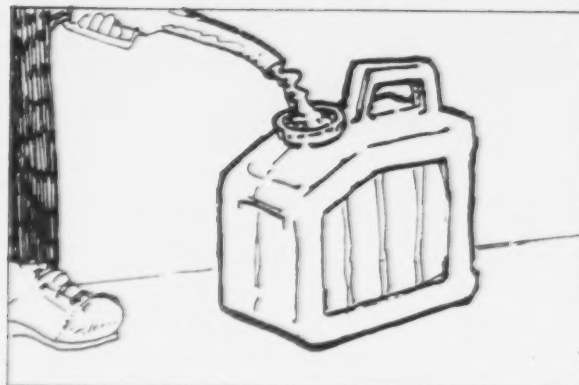


11. **If gasoline leaks, open the shop doors and start the ventilation system.** Wipe up any gasoline spilled on the floor immediately.

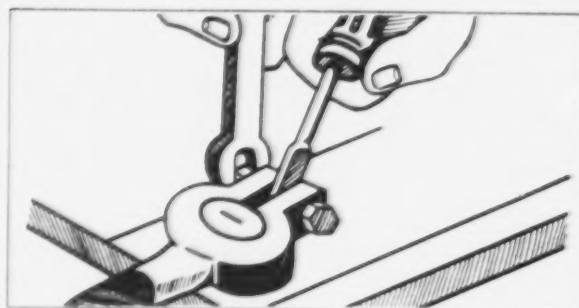


12. **Fix gasoline leaks on vehicles as soon as possible.** Follow proper procedure. **DO NOT TRY TO FIX A LEAK WITHOUT PROPER INSTRUCTION!**

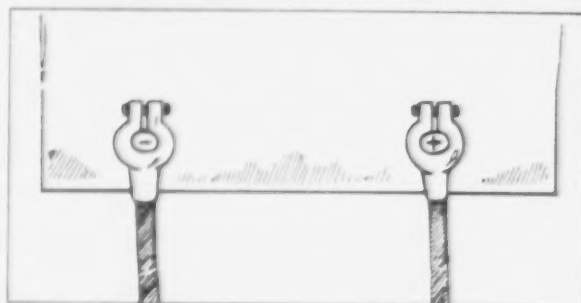
13. **Store gasoline only in approved containers. NEVER store it in a glass container.**



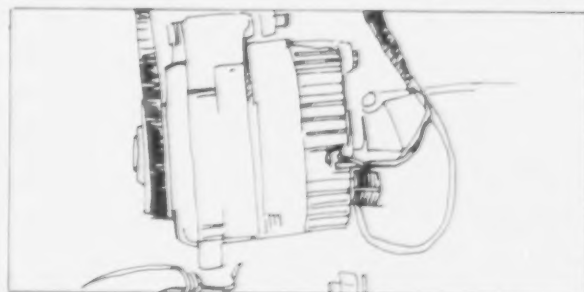
14. **Remove the ground (negative) cable from the battery before removing the positive cable.**



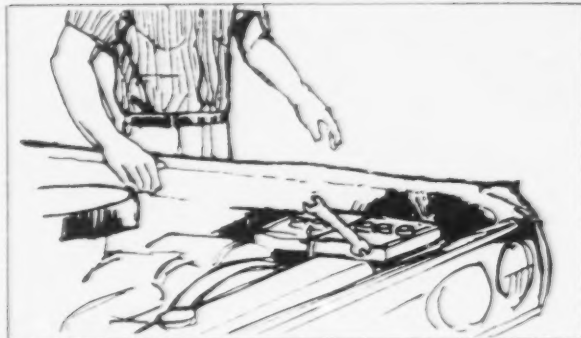
15. **Disconnect the battery cables before using the ohmmeter.**



16. **Do not allow the output terminal of the alternator to touch any metal parts if the battery is still connected.**

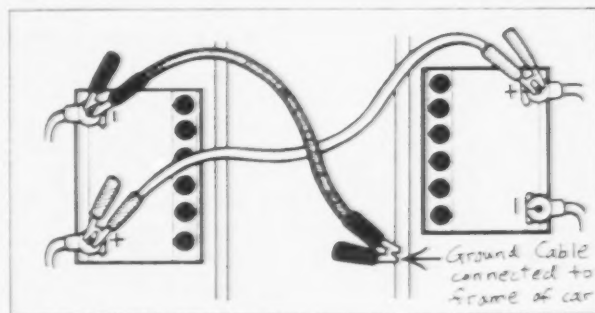


17. To prevent sparks, fire or explosion, never lay anything on the battery terminals.

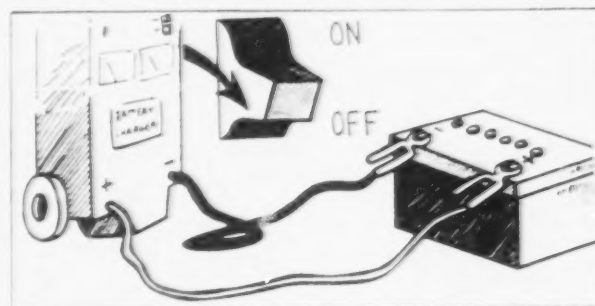


18. Disconnect the battery before you start to work on a vehicle. Be especially careful when you are replacing electrical components.

19. When you are using jumper cables, always connect the ground cable to the frame or engine.



20. When you are using a battery charger, disconnect the battery cables and connect the charger to the battery before turning on the charger.



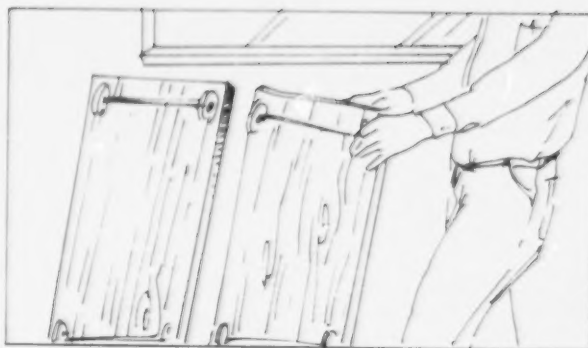
21. Do not operate any piece of equipment unless you have been properly instructed on its use. If you are still unsure, ask for help.



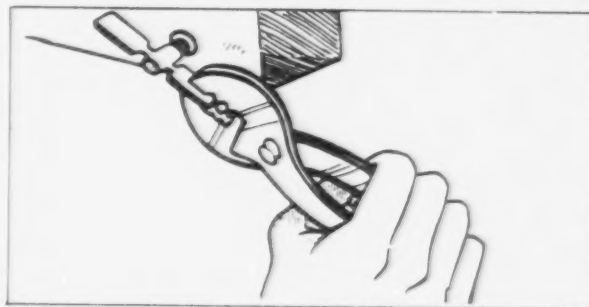
22. Get permission from the instructor before you use a piece of equipment.

23. Keep tools and equipment under control at all times.

24. Do not leave creepers lying on the floor. Stand them against a wall with their wheels outward when you are not using them.



25. Keep tools, especially handles, free from oil and grease.



26. Check electrical cords before using equipment.



DO SKILL SHEET 2

DO ACTIVITY SHEET 2

SAFETY

SKILL SHEET 2

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. When they are not being used, place creepers against the wall with wheels turning inward.
- _____ 2. It is safe to use compressed air to blow dirt off your clothes.
- _____ 3. You should disconnect the battery before you start to work on the vehicle.
- _____ 4. It is safe to leave damaged sheet metal on the floor until you have time to hide it under a car.
- _____ 5. It is safe to test spraying equipment by holding your hand in front of its nozzle.
- _____ 6. It is safe to allow lead wires to fall into the fan of a running engine.
- _____ 7. It is safe to store gasoline in glass containers.
- _____ 8. When gasoline leaks, open the shop doors and wipe up the gas immediately.

- _____ 9. You should remove the battery's positive cable before you remove the negative cable.
- _____ 10. It is not safe to lay anything across the battery terminals.
- _____ 11. When you use jumper cables, you should always connect the ground cable to the frame or engine.

SHOP SAFETY

ACTIVITY SHEET 2

Directions: Look around the shop and note any potentially dangerous situations. Make sure you look at tools and equipment, waste containers and aisle areas. Discuss your findings with your instructor.

E. FIRE SAFETY

Fire is always a danger in the auto body shop. Because the body shop uses many flammable materials, everyone must be careful not to start a fire.

There are four types of fires. Fire extinguishers are marked with standard symbols so you can know the right extinguisher to use for a particular kind of fire.

1. **Type A** fires are those in which ordinary combustibles (wood, paper and cloth) are burning.
2. **Type B** fires are those in which flammable liquids or grease (gasoline, paints or oil) are burning.
3. **Type C** fires are those in which electrical equipment (motors, switches or wires) are burning.
4. **Type D** fires are those in which combustible metals (magnesium, iron, etc.) are burning.

Green



Ordinary
Combustibles

Red



Flammable
Liquids

Blue



Electrical
Equipment

Yellow



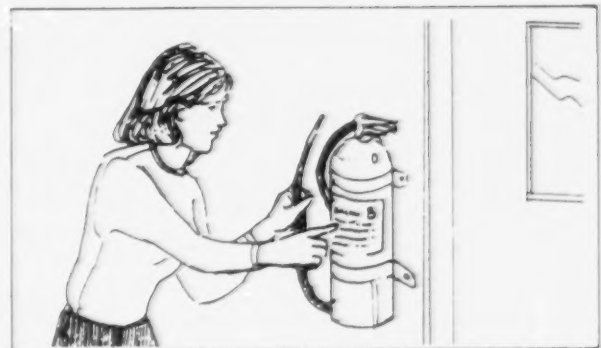
Combustible
Metals

There are four classes of fire extinguishers:

- A. **Class A** is plain water.
- B. **Classes B, C** may be carbon dioxide, ordinary dry chemical or halon.
- C. **Classes A, B, C** are multipurpose chemicals.
- D. **Class D** is a dry powder.

FIRE SAFETY IN THE AUTO BODY SHOP

1. **Know where the fire safety equipment is.** Learn where the fire extinguishers are. (They should be marked with a symbol that tells you the type.) Know how to use the fire extinguishers in your shop.
2. **Learn where the fire alarm switch is.** Do not hesitate to use it right away if a fire has any possibility of getting out of control.

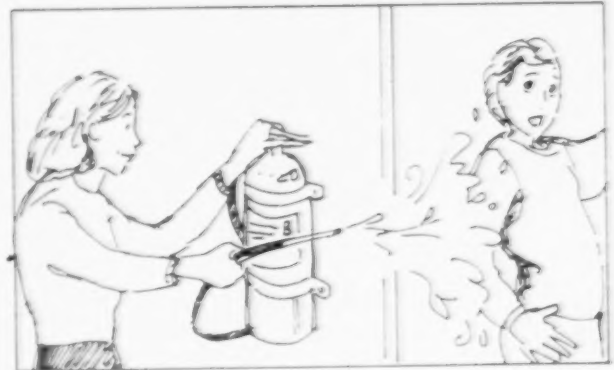


3. **Learn how to use a "fire blanket."**

A "fire blanket" is made of flame-retardant material and is used to wrap around a victim whose clothes are on fire. If someone's clothes catch fire, get the blanket quickly. Wrap it around the person to smother the fire.



3. **Never play with a fire extinguisher!** If you empty the extinguisher, it may not be ready to use in an emergency.



DO SKILL SHEET 3

DO ACTIVITY SHEET 3

SAFETY

SKILL SHEET 3

Directions: Pictured below are universal symbols for fire extinguishers. Match the type of fire with the extinguisher you would use.

A. Combustible metals

C. Flammable liquids

B. Ordinary combustibles

D. Electrical equipment

___ 1.

Blue



___ 2.

Red



___ 3.

Yellow



___ 4.

Green



Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 5. The main purpose of fire blankets is to smother trash fires.
- _____ 6. If it looks as if a fire may get out of control, you should set off the fire alarm.
- _____ 7. Type B fires occur when ordinary combustibles such as paper or cloth burn.
- _____ 8. Type D fires occur when combustible metals such as magnesium and iron burn.
- _____ 9. Type C fires occur when electrical equipment burns.
- _____ 10. Any type of fire extinguisher can be used to put out a fire.

SAFETY

ACTIVITY SHEET 3

Directions: Locate the fire extinguishers in the shop. Show how to use each one.

F. CHEMICAL SAFETY

Dangerous chemicals are all around in the auto body shop. Unless you follow safety rules, many of these materials can harm or kill you. You come in contact with dangerous chemicals when you work with:

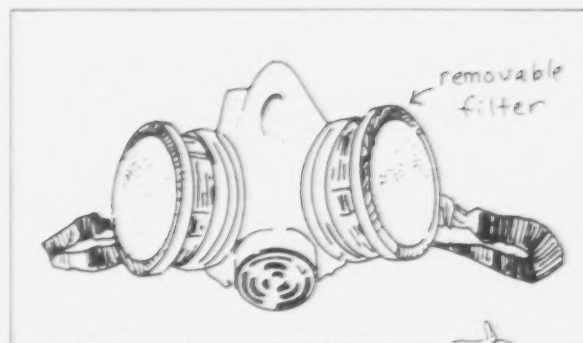
- paint and refinishing material
- plastic and fiberglass fillers
- gasoline
- batteries
- air conditioning systems

Paint particles and the dust from sanded paint can stick to your lung's air passages and partially clog them. Paint fumes, some of which are poisonous, can cause headaches and stomachaches. All paint products can cause eye trouble. Some could blind you if they splashed into your eyes. Constant exposure to painting material can irritate your skin.

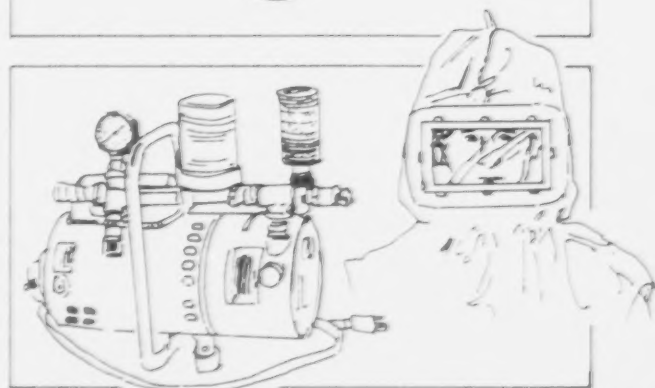
1. **Wear a respirator, especially if the paint contains isocyanates.** An air-line respirator with a full hood or half mask is best. If this is not available, use a respirator that is approved for use with isocyanate vapors and mists.



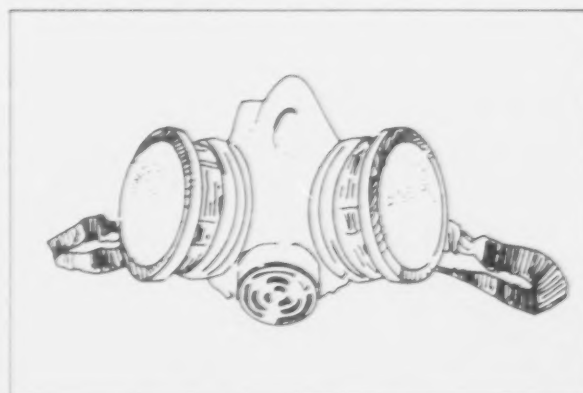
A. When refinishing, use a respirator with a removable filter. Removable filters catch paint particles and most paint fumes by filtering the air you breathe. **Replace filters after each paint job.** Don't clean them.



B. When working with toxic paints, use an air supply respirator. Air supply respirators provide safe air you can breathe through air lines. The hose assembly is belted to the waist to avoid damaging the hose.



C. For some spraying situations, a charcoal mask is effective. A charcoal mask filters particles and fumes from the air you are breathing. Read the manufacturer's recommendations to determine when a charcoal mask is suitable.



2. Do not wash materials from hands with paint thinner or reducer. These chemicals can cause a rash and can be absorbed through the skin. They may cause liver damage.



3. **Wear rubber gloves when handling paints, thinners, plastic fillers and other refinishing materials.** Always follow the recommendations for the material with which you are working.
4. **Always keep paints and thinners in closed containers.**
5. **Do all painting in a spray booth.**
6. **Always follow the safety precautions recommended by the manufacturer of the material with which you are working.**
7. **Wear rubber gloves, splash-resistant goggles, protective clothing and a respirator when you use chemicals or corrosion-protection material.** Follow the directions on the label.

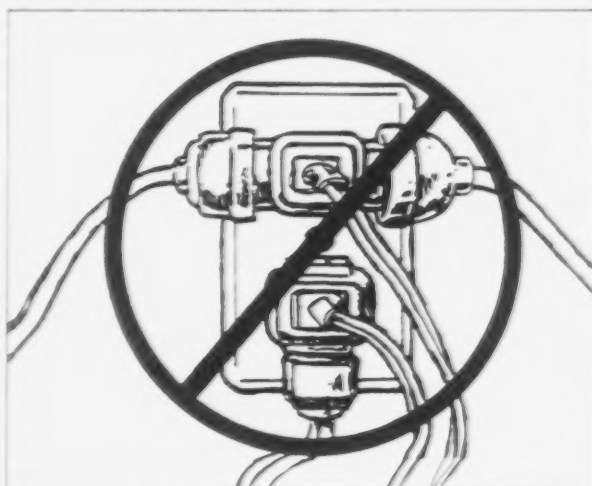
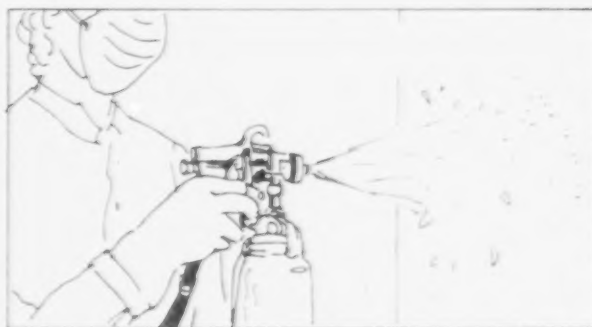


8. When sanding, grinding or spraying, do not allow any person not wearing protective gear in the work area.

9. Read and understand instructions, labels, and caution signs on chemicals before using them. Protect yourself against inhaling or swallowing fumes. Protect yourself against chemical contact with eyes and skin.

10. NEVER place your bare hand over the outlet nozzles of spray equipment when spraying paint products.

11. Do not overload circuits by connecting extra electrical equipment to a circuit in or near a paint room or paint material storage area. Most paints are flammable. Some are explosive.



DO SKILL SHEET 4

DO ACTIVITY SHEET 4

SAFETY

SKILL SHEET 4

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. Some paints can blind you if they are splashed in your eyes.
- _____ 2. It is safe to use paint thinner to wash paint from your hands.
- _____ 3. It is safest to paint in a spray booth.
- _____ 4. Wear cotton gloves when working with corrosion protection materials.
- _____ 5. People working near other people who are sanding, grinding and spraying should wear protective equipment too.
- _____ 6. Paint materials can explode when sparks are around.
- _____ 7. You should wear splash-resistant safety goggles when working with paint or chemicals.
- _____ 8. You should wear a respirator when working with materials or chemicals that are dangerous.
- _____ 9. Wear respirators with removable filters when working with paint.

- _____ 10. You should read and understand manufacturer's instructions, warning labels, and other information on the package before using the product.
- _____ 11. Replace respirator filters after every paint job.
- _____ 12. Particle masks are the same as respirators.
- _____ 13. It is safe to test a spray nozzle with your hand.
- _____ 14. Protective clothing is not necessary when working with chemicals.
- _____ 15. It is safe to read the label at the same time you are using the material.

SAFETY

ACTIVITY SHEET 4

Directions: Using the container of a chemical your instructor has provided, explain what safety equipment should be worn and what rules should be followed.

SAFETY

UNIT TEST

Directions: Match the definition on the left with the term on the right.

- | | |
|---|--------------------|
| _____ 1. Federal agency that makes sure working conditions are safe for workers | A. Ventilation |
| | B. Carbon monoxide |
| | C. Combustible |
| | D. OSHA |
| _____ 2. Poisonous | E. Toxic |
| | F. Vapors |
| _____ 3. A very poisonous gas you can't see or smell | |
| _____ 4. Capable of burning | |
| _____ 5. Steam, smoke; anything that vanishes like mist | |
| _____ 6. Circulation of air | |

- | | |
|--|--------------------|
| _____ 7. Pollutants | A. Contaminants |
| | B. Asbestos |
| _____ 8. Applying oil to make parts
move easily | C. Flammable |
| | D. EPA |
| | E. Lubrication |
| _____ 9. Unable to produce flames | F. Flame retardant |
| _____ 10. Can be easily ignited
and/or can burn quickly | |
| _____ 11. Incombustible material
used in clutches and
brakes | |
| _____ 12. Agency that tries to keep
the environment safe | |

Directions: Fill in the blanks with one word from the group of words listed below. Some words will not be used.

Compressed air	Match	Back	Steel-toed	Battery	Loose
Ventilated	Jewelry	Light	Shoulder	Tight	Tennis

13. _____ should not be worn in the shop.
14. Do not use _____ to clean brake and clutch parts.
15. The _____ should be disconnected as soon as the vehicle is brought into the shop.
16. _____ muscles are used to lift.
17. _____ fitting clothes should be worn in the shop.
18. _____ shoes are safe to wear in the shop.

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 19. Type A fires are of common combustibles such as paper or cloth.
- _____ 20. Respirators should be worn when grinding plastic fillers.
- _____ 21. Gasoline should be stored in glass containers.
- _____ 22. Always read and follow manufacturer's directions.

_____ 23. Creepers are placed against the wall with the wheels turning outward when they are not being used.

_____ 24. It is unsafe to use compressed air to blow dirt off of clothing.

SAFETY

PERFORMANCE CHECKLIST

Student _____ has successfully performed the following tasks:

	YES	NO	COMMENTS
1. Identified government agencies that regulate safety in the auto body shop			
2. Identified personal safety rules for the auto body technician			
3. Identified auto body shop safety rules			
4. Demonstrated proper use of fire-protection equipment			
5. Identified chemical safety rules			

Satisfactory - Should move on

☐

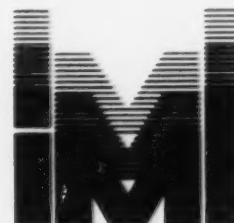
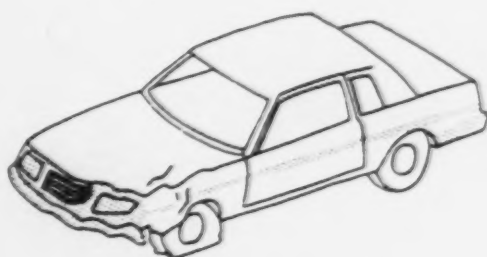
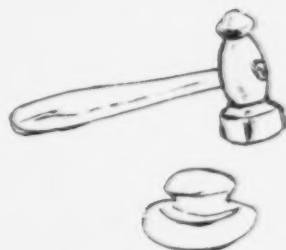
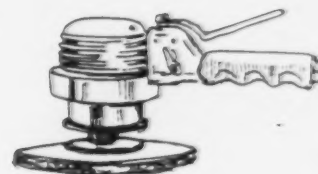
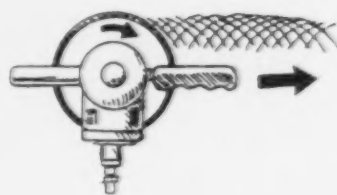
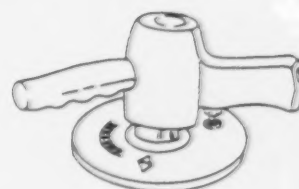
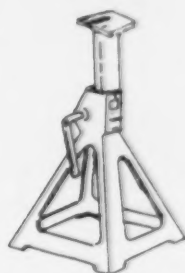
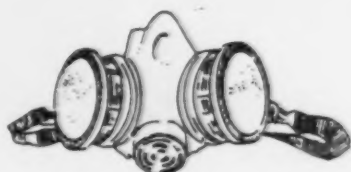
Repeat this unit

☐

Student's Signature/Date _____

Instructor's Signature/Date _____

LIFTING AND JACKING



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

LIFTING AND JACKING INTRODUCTION

Jacks lift vehicles off the ground. After the vehicle has been raised, safety stands hold it securely in place. It is then safe for an auto body worker to work under the vehicle.

UNIT OBJECTIVE

After completing this unit, you should be able to use jacks and safety stands safely.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Identify common jacks and safety stands.
2. Demonstrate proper lifting and jacking techniques.
3. Identify specific jacking points for conventional frames and unibody cars.
4. Tell how to lift unibody and frame vehicles and place supporting safety stands.

Put a check beside the statement that is true for you.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

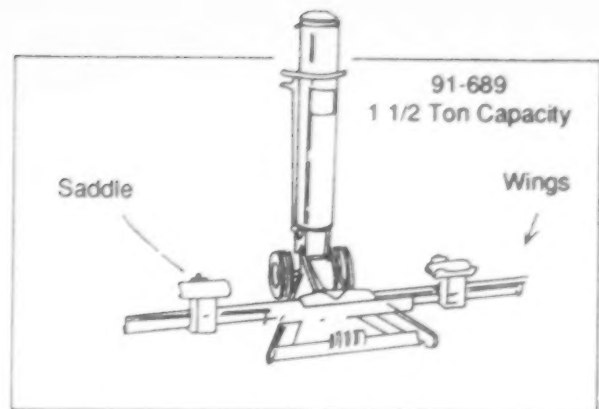
A. TERMS AND EQUIPMENT

1. **Conventional frame** - an auto body construction type in which the engine and body are bolted to a separate frame. "Conventional frame" vehicles may also be called "frame body" vehicles. These are usually older vehicles.
2. **Crossmembers** - the frame pieces that connect the side rails.
3. **Hydraulic** - a system in which force is exerted through oil or other liquids in a closed system of cylinders and tubing.
4. **Jacking points** - places on the frame where jacks can safely be placed during the lifting/jacking process.
5. **Pneumatic** - powered by air.
6. **Side rails** - the side beams of the automobile body frame.
7. **Torque boxes** - attached to some frames, torque boxes are metal boxes that twist and turn to absorb road shock and minor collision shocks.
8. **Unibody construction** - a vehicle in which the body and frame are welded together to form one unit. Unibody vehicles can also be called "unitized body-frame" vehicles. This is the modern design used for most of today's vehicles.

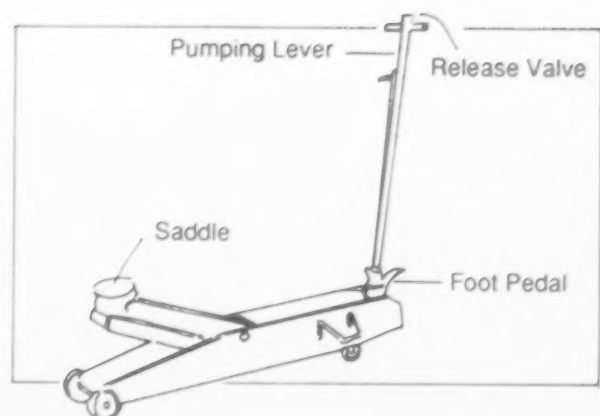
B. EQUIPMENT

1. Bumper-type end lift jack -

Designed for high lifting, it is the most common type of pneumatic floor jack. It lifts one end of the vehicle at a time. Usually you place it under the bumper. After the vehicle is raised, you use frame stands for support.

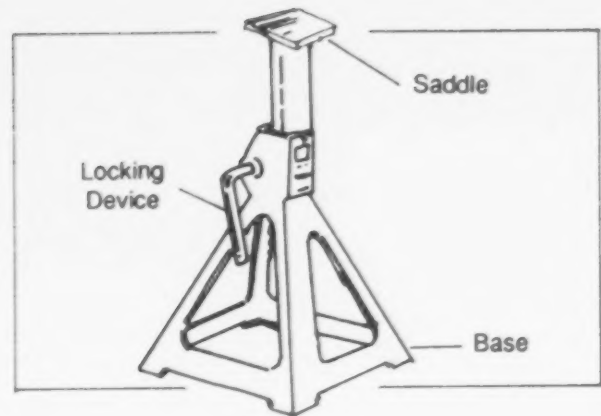


2. Floor jack - This jack is "pumped up" by a lever. A foot pedal brings the saddle up to the load. Use the hydraulic floor jack to raise a vehicle so that you can place safety stands or frame stands under it.



AUTO BODY LIFTING AND JACKING

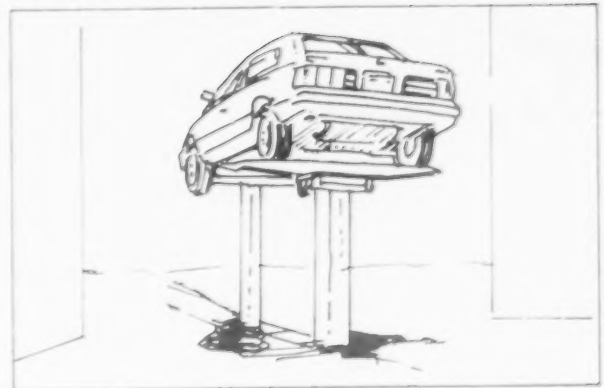
3. Safety stands - These are used to support a vehicle for inspection or repairs. You use jacks for lifting, not for holding the vehicle safely.



C. SAFETY RULES

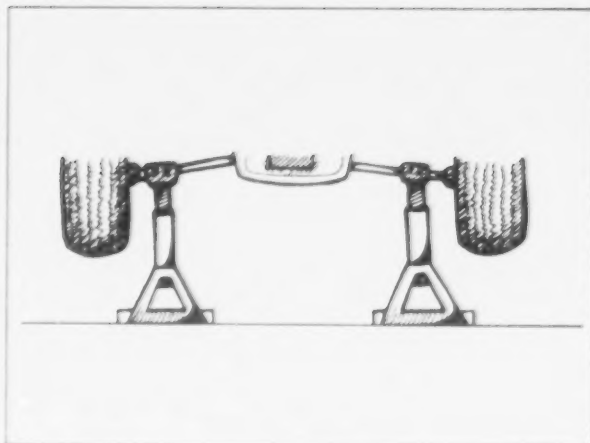
If you place a jack wrong, it can cause a great deal of damage to a vehicle. It can also cause injury to you or to other auto body technicians. Follow these rules:

1. **Make sure the equipment is in good shape.** Don't use jacks with hydraulic leaks.
2. **Check the jack's load limit, which is printed on the jack.** Be sure the jack is strong enough for the job.

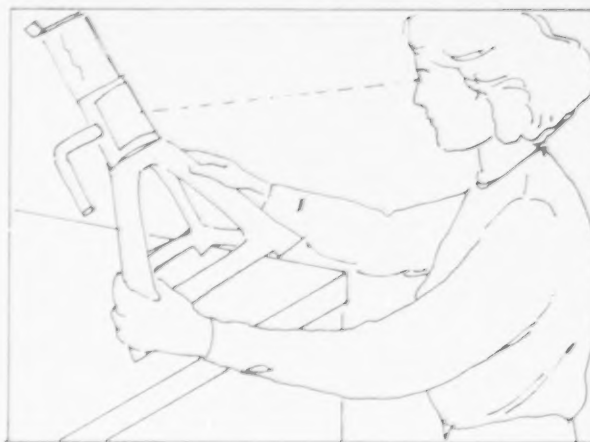


3. **NEVER** get under a car until safety stands are in place.

4. Check the car's service manual for specific jacking and supporting points.



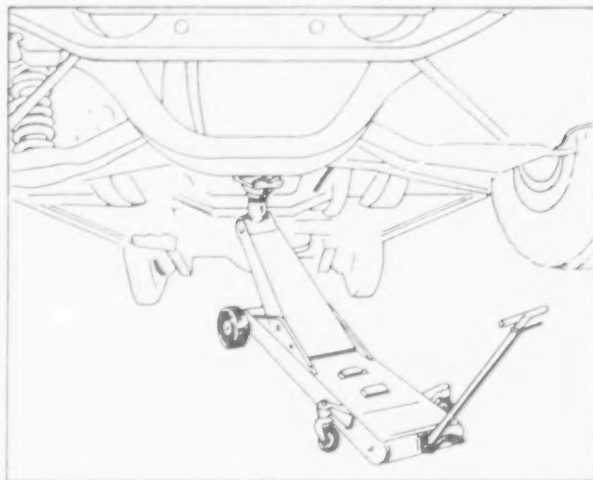
5. Check the load limit printed on the safety stands to make sure they will safely hold the load.



6. **NEVER** rock a vehicle that is on safety stands.

7. After raising a vehicle with a floor jack, be sure the jack handle is pointed straight up.

8. Do not lift vehicles with passengers inside.



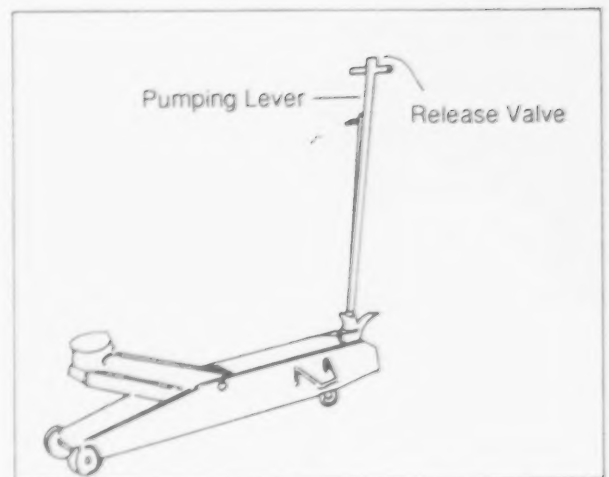
AUTO BODY LIFTING AND JACKING

9. Before lifting a car, be sure its doors, hood and deck lid are closed.

10. Always be sure safety stands are in place before lowering the jack.

11. Make sure everyone is away from the raised vehicle before you open the release valve to lower it.

12. When you lower a car, open the release valve a little and then close it so the car is lowered a little at a time. If the release valve is opened all the way, the vehicle will drop to the floor instantly. The sudden drop may cause damage or injury.



DO SKILL SHEET 1

DO ACTIVITY SHEET 1

LIFTING AND JACKING

SKILL SHEET 1

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. The jack handle should point up after the vehicle has been raised.
- _____ 2. When lowering the vehicle, it is safest to open the release mechanism all the way.
- _____ 3. If hydraulic jacks have a leak, do not use them.
- _____ 4. Before you use a jack, it is safest for the release valve to be opened all the way.
- _____ 5. Before lifting a vehicle, make sure the doors are open.
- _____ 6. You should look at the vehicle's service manual to find the proper jacking point.
- _____ 7. People should not be standing close to a vehicle when the release valve is opened.

- _____ 8. It is safe to lift a vehicle with people in it as long as the people do not weigh more than 200 pounds and they are wearing their seat belts.
- _____ 9. You should never crawl under a lifted vehicle unless safety stands are supporting it.
- _____ 10. The load limit of safety stands is found in the dictionary.

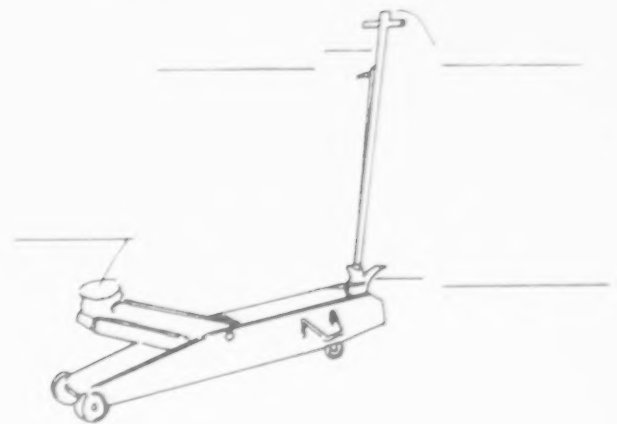
LIFTING AND JACKING

ACTIVITY SHEET 1

Directions: Using jacks and safety stands provided by your instructor, identify the following pieces of equipment and their parts.

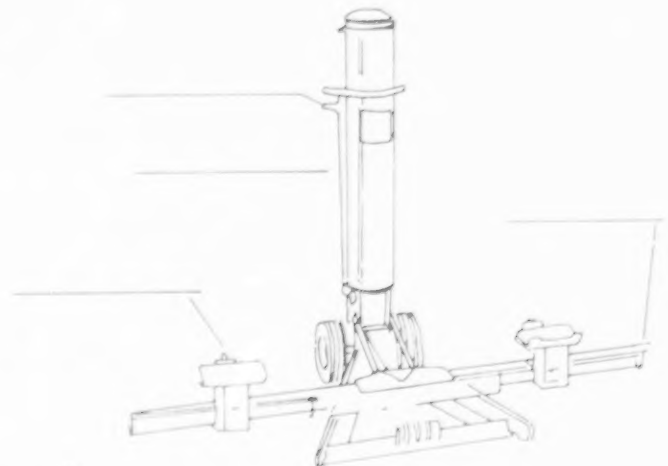
Floor jack

- pumping lever
- foot pedal
- saddle
- release valve



Bumper-type end lift jack

- saddles
- wings
- release valve
- safety lock

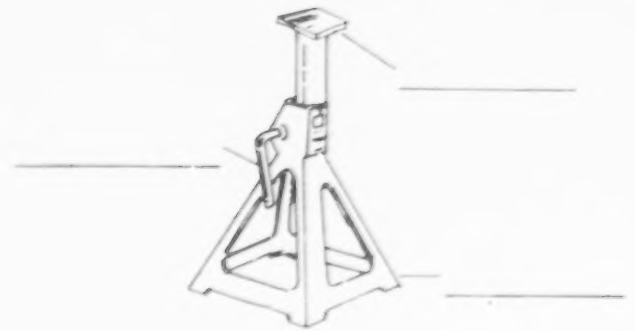


Safety stand

base

saddle

locking device

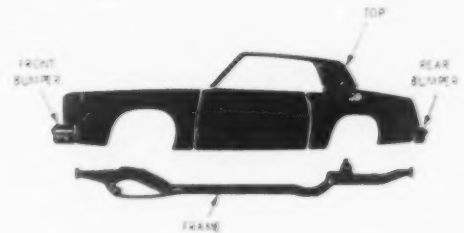


AUTO BODY LIFTING AND JACKING

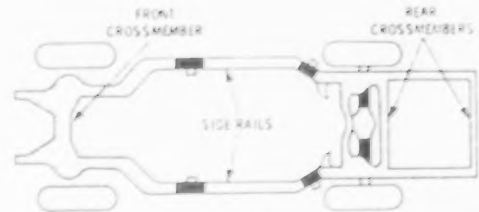
D. JACKING (CONVENTIONAL FRAME AND UNIBODY)

1. Conventional body frame.

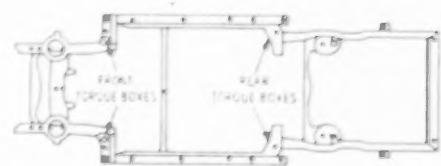
The conventional body frame is built in pieces. The body and other major parts are usually bolted to the frame.



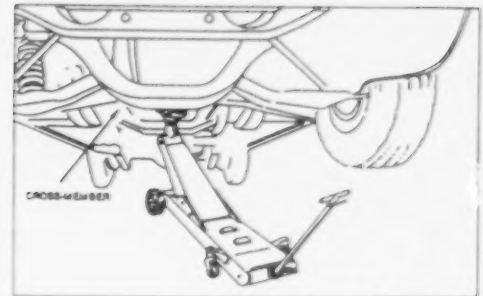
Two long beams, called "side rails," run the full length of the vehicle. Shorter beams, called "cross members," run from side to side and hold the side rails in place.



The side rails have pieces of metal welded together that form boxes called "torque boxes." Torque boxes, by twisting and turning, allow the car to absorb road shock and small collision shocks. Torque boxes are found at each corner of the passenger compartment.



On conventional frame vehicles, you usually place the jack under the **center of the front or rear crossmember** to raise the vehicle. You can also place jacks under a **side rail**.



Remember, jacks are for lifting--not for holding. Once the vehicle is lifted, place safety stands under the torque boxes for support.

NOTE: Check the vehicle's service manual for specific jacking and supporting points, as well as the proper jack to use.

2. **Unibody frame.** In unitized frame construction (unibody), the body panel and frame sections are welded or spot-welded together to form one unit.



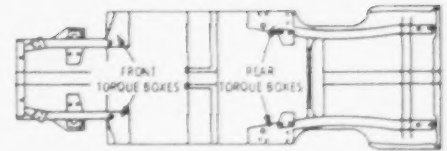
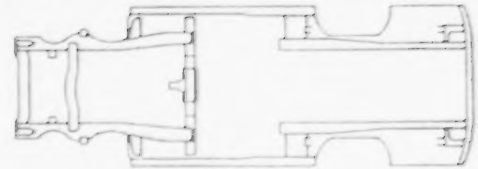
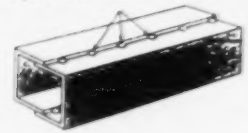
AUTO BODY LIFTING AND JACKING

The metal used in unitized frames is thinner steel than the metal used in frame body construction. Most of the frame section panels are made with a box-like construction.

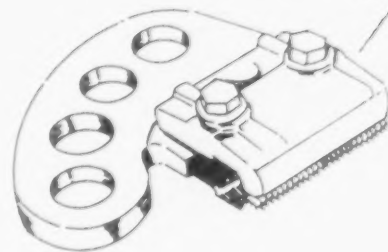
You will also find **torque boxes** on unitized body frames. These areas are usually strong places to lift and support the vehicle.

The points where two panels are spot-welded are called "pinch welds." **Pinch welds are the strongest areas of unibody construction** for lifting and supporting. You can raise most unibody vehicles by attaching pinch weld clamps to the pinch weld.

Heavy
Spot Welds



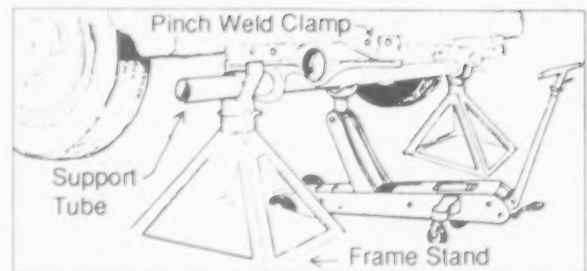
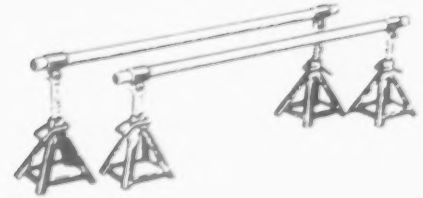
Pinch Weld
Clamp



Support tubes are then placed between the pinch weld clamps. After you place a jack under the center of the support tube, raise the vehicle one end at a time. Then place safety stands under the ends of the support tubes.

NOTE: Check the vehicle's service manual for correct jacking and support points.

The following procedure will use a hydraulic jack.



AUTO BODY
LIFTING AND JACKING

E. LIFTING AND SUPPORTING VEHICLES USING A HYDRAULIC JACK

1. Equipment:

Floor jack

Safety stands

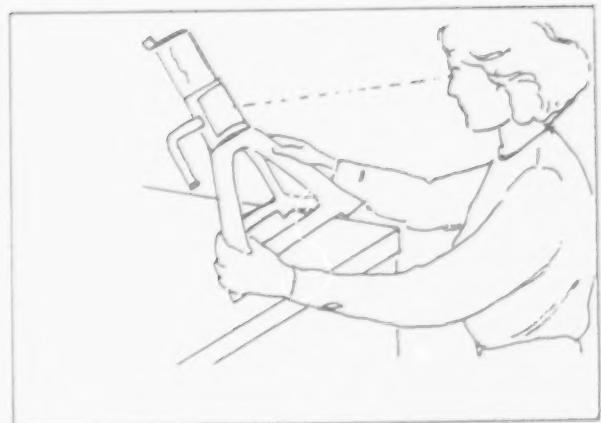
Safety glasses

Support tube

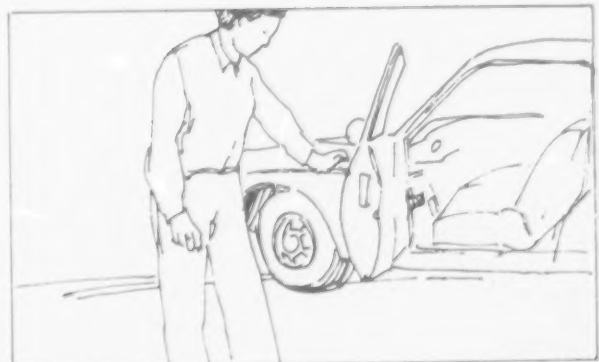
Pinch weld clamps

2. Check the equipment.

Make sure there are no leaks in the jack. Check load limits on both the jack and safety stand.



3. Look in the service manual to find out where the jacking and support points are. Locate the points on the vehicle.



4. Make sure the doors, deck lids and hood are closed.

5. PUT ON SAFETY GLASSES.

6. Make sure the release valve on the jack is closed.

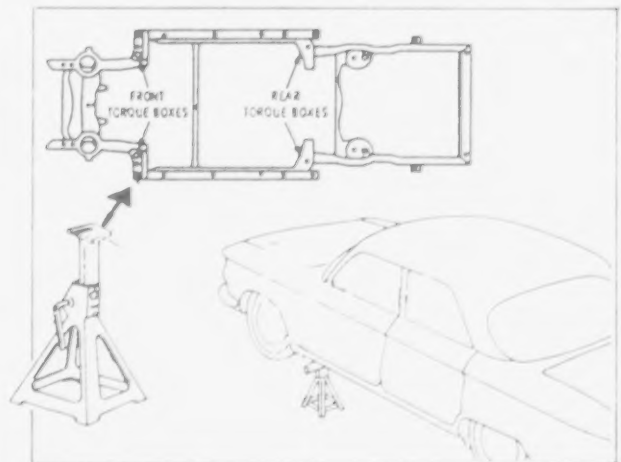
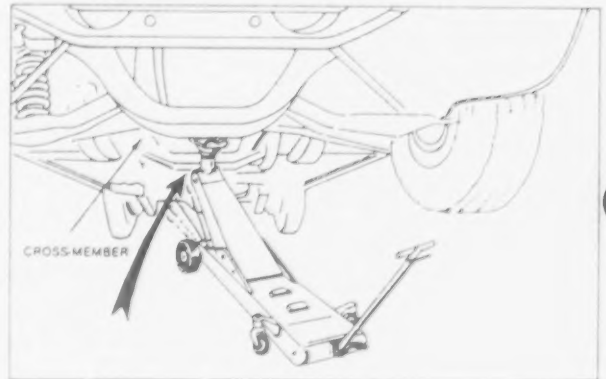
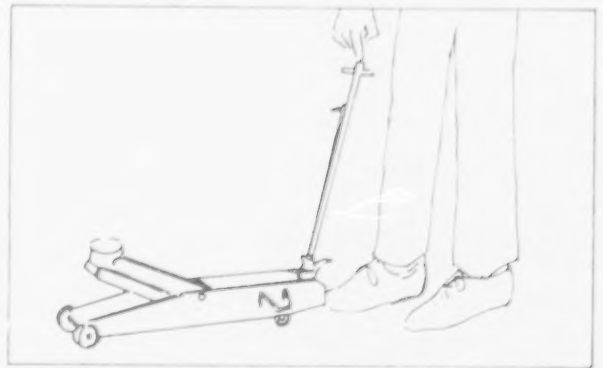
NOTE: If pinch welds are the jacking points, go to step 13 after you complete step 6.

7. Slide the jack under the jacking point.

8. Lift the vehicle high enough to place safety stand under the support point.

9. Place the safety stand under the support point.

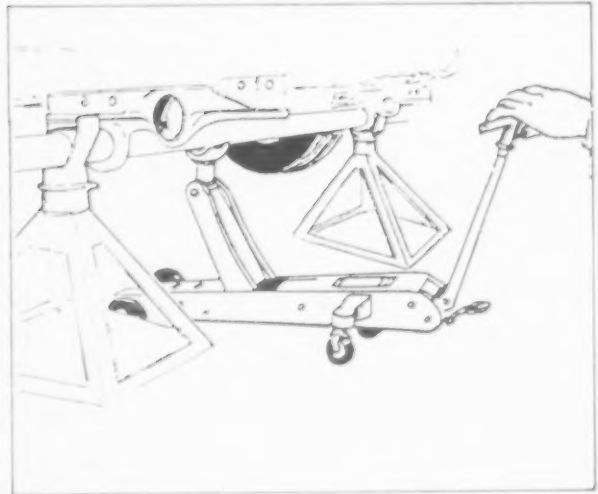
NOTE: Make sure the jack handle is pointing straight up.



AUTO BODY
LIFTING AND JACKING

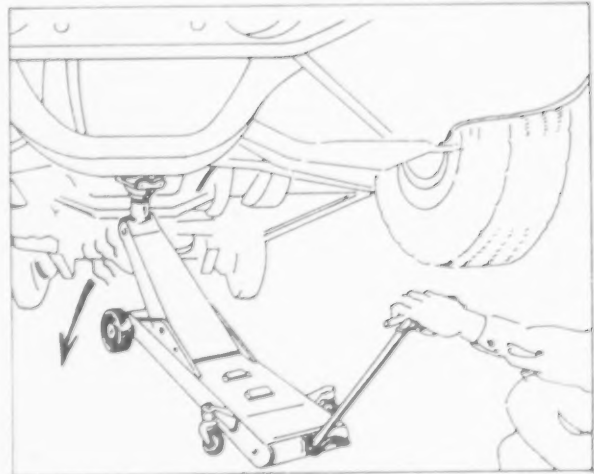
10. Slowly open and close the release mechanism.

NOTE: After the vehicle has been lowered to the support device, make sure the device is still in the proper place.



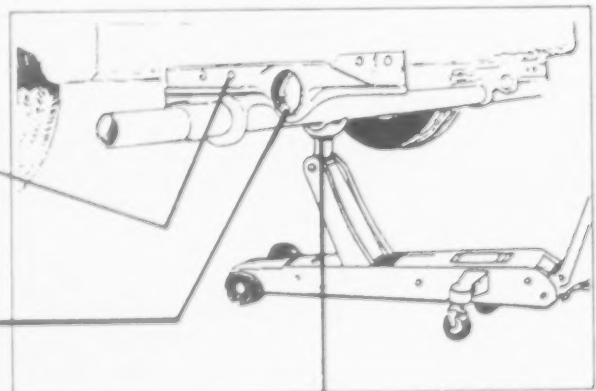
11. Lower the jack completely.
Store it in the proper place.

12. Pull the jack from under the vehicle.



13. Attach the pinch weld clamp to the pinch weld area.

14. Put the support tube through the pinch weld clamp.



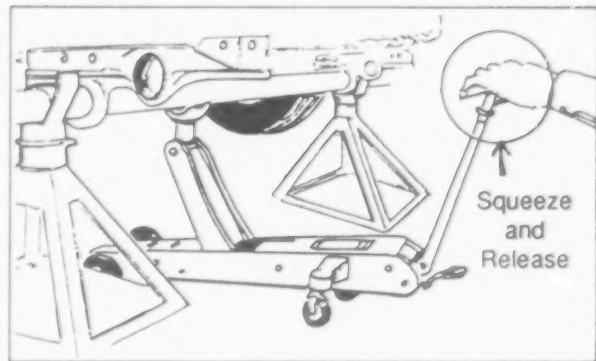
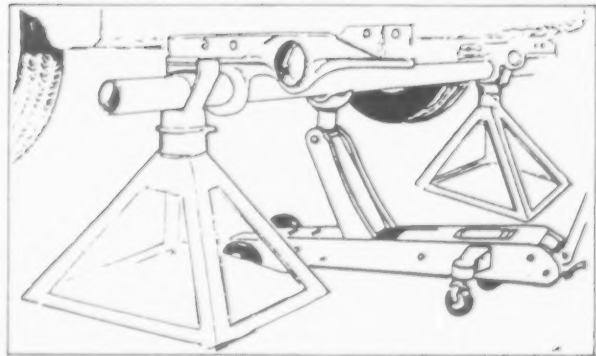
15. Place the jack under the center of the support tube.

16. Lift the vehicle.

17. Place a safety stand near each end of the support tube.

18. Slowly open and close the release mechanism until the jack has been lowered completely.

19. Pull the jack from under the vehicle. Store it in the proper place.



LIFTING AND JACKING
ACTIVITY SHEET 2

Equipment:

Hydraulic jack
Safety stands
Safety glasses
Support tube
Pinch weld clamp

Procedure

Evaluation

3 2 1 N

- | | | | | |
|--|---|---|---|---|
| 1. Check equipment | — | — | — | — |
| 2. Refer to service manual | — | — | — | — |
| 3. Shut doors, deck lid and hood | — | — | — | — |
| 4. Put on safety glasses | — | — | — | — |
| 5. Close release valve on jack | — | — | — | — |
| 6. Jack under proper jacking point | — | — | — | — |
| 7. Correct jacking technique | — | — | — | — |
| 8. Position safety stand in correct place | — | — | — | — |
| 9. Lower jack using correct technique | — | — | — | — |
| 10. Pull jack from under vehicle and store | — | — | — | — |

USING PINCH WELD FOR JACKING

1. Inspect equipment - - - -
2. Refer to service manual - - - -
3. Shut doors, deck lid and trunk - - - -
4. Put on safety glasses - - - -
5. Close release valve on jack - - - -
6. Jack under proper jacking point - - - -
7. Correct jacking technique - - - -
8. Position safety stands in correct place - - - -
9. Lower jack using proper technique - - - -
10. Pull jack from under vehicle and store - - - -

55

**F. LIFTING AND SUPPORTING VEHICLES USING A BUMPER-TYPE
END LIFT JACK**

1. Equipment:

Bumper-type end lift jack

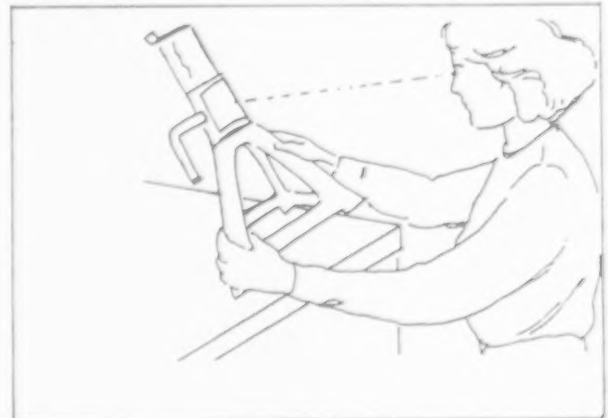
Safety stands

Safety glasses

Air supply

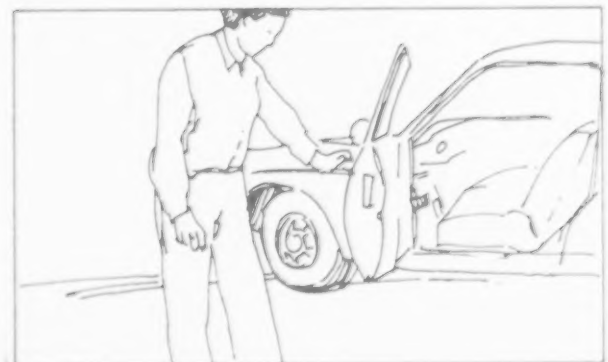
NOTE: This section uses a bumper-type end lift jack. If your shop does not use one, you may need to adapt the procedure to your jack. Some vehicles cannot be lifted with the bumper-type end lift jack.

2. Check the equipment. Make sure each piece works properly.



3. Refer to the service manual for jacking and support points.

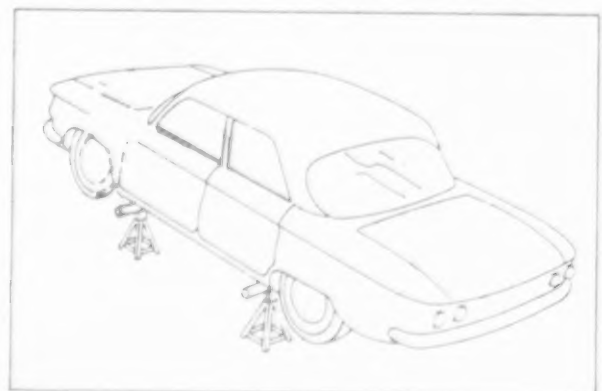
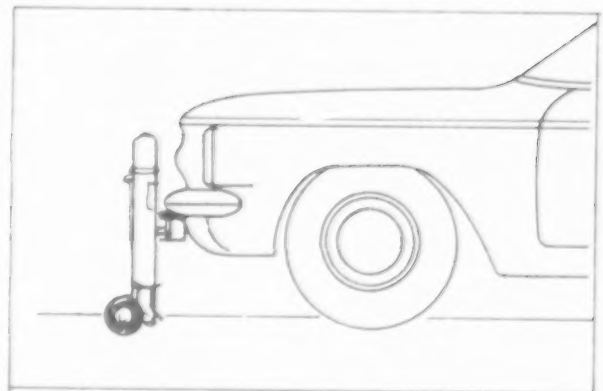
4. Make sure the doors, deck lids and hood are closed.



5. Position the jack under the proper jacking points.
6. Connect the jack to the air supply.
7. Lift the vehicle.

NOTE: Proper use of jacks vary a great deal. Read the manufacturer's directions for the correct way to use the jack.

8. Position the safety stands in the proper support points.
9. Lower the jack a little at a time.



**AUTO BODY
LIFTING AND JACKING**

NOTE: After the vehicle has been lowered onto the support device, make sure the device is still in the proper place.

10. Lower the jack completely.

DO SKILL SHEET 2

DO ACTIVITY SHEET 3

LIFTING AND JACKING
ACTIVITY SHEET 3

Equipment:

Bumper-type end lift jack
Safety stands
Safety glasses
Air supply

Procedure

Evaluation

3 2 1 N

1. Check equipment for safety
2. Refer to service manual
3. Close doors, deck lid and hood
4. Put on safety glasses
5. Connect jack to air supply
6. Position jack under correct jacking point
7. Lift vehicle
8. Position safety stands
9. Lower jack using correct procedure

— — — —
— — — —
— — — —
— — — —
— — — —
— — — —
— — — —
— — — —
— — — —

LIFTING AND JACKING
SKILL SHEET 2

Directions: Fill in the blanks with the words provided below.

Side rails	Pinch welds	Torque boxes
Unibody	Conventional body frame	Crossmembers

1. _____ are the strongest areas of unibody construction for lifting and supporting.
2. _____ absorb road shock and minor collision shock.
3. In _____ construction, the body panel and frame sections are welded together in one unit.
4. In _____ construction, the body pieces are bolted to the frame.
5. Beams that run the full length of the vehicle are called _____.

6. Shorter beams that run from side to side are called _____.

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

_____ 7. The bumper-type end lift jack can be used to lift all kinds of vehicles.

_____ 8. Torque boxes absorb road shock.

_____ 9. It is safest to raise the entire vehicle at once.

_____ 10. Steel used for unitized frames is thinner than steel used for frame body construction.

LIFTING AND JACKING

UNIT TEST

Part 1. Directions: Match the definition on the left with the word(s) on the right.

- | | |
|---|-------------------------|
| ___ 1. Steel beams that run the full length of the vehicle | A. Conventional frame |
| | B. Cross-members |
| | C. Hydraulic |
| ___ 2. Places on the frame where jacks can safely be placed during the lifting/jacking process | D. Jacking point |
| | E. Pneumatic |
| | F. Side rails |
| | G. Torque boxes |
| | H. Unibody construction |
| ___ 3. Frame pieces that connect the side rails | |
| ___ 4. A type of construction in which the body and frame are welded together to form one unit | |
| ___ 5. Powered by air | |
| ___ 6. Relating to the exerting of force by oil or other liquids in a closed system of cylinders and tubing | |

- ___ 7. Pieces of the frame that twist and turn to absorb road shock and minor collision shocks.
- ___ 8. A type of auto body construction in which the engine and body are bolted to a separate frame.

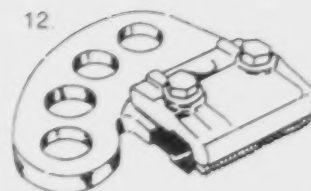
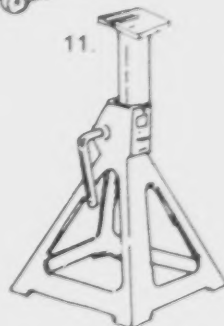
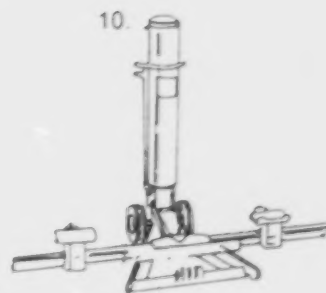
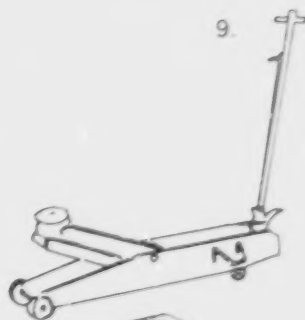
Part 2. Directions: Write the name of the following pieces of equipment in the blanks provided.

9. _____

10. _____

11. _____

12. _____



AUTO BODY
LIFTING AND JACKING

Part 3. Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 13. Jacking points are the same on all vehicles.
- _____ 14. It is not safe to crawl under a vehicle until it has been securely placed on safety stands.
- _____ 15. Unibody frames are made of heavier metal than conventional frames.
- _____ 16. To lift at a pinch weld, you should use a pinch weld clamp.
- _____ 17. When using a support tube for jacking, the jack is placed at the end of the tube.
- _____ 18. It is safe to lift an entire vehicle with one quick movement.
- _____ 19. It is not safe to lift a car that has passengers in it.
- _____ 20. You should look in the service manual to find the proper jacking points of a vehicle.

AUTO BODY
LIFTING AND JACKING

LIFTING AND JACKING

PERFORMANCE CHECKLIST

Student _____ has successfully performed the following tasks:

	YES	NO	COMMENTS
1. Identified common jacks and safety stands.			
2. Demonstrated proper lifting and jacking techniques.			
3. Identified specific jacking points for conventional frames and unibody cars.			
4. Told how to lift unibody and frame vehicles onto safety stands.			

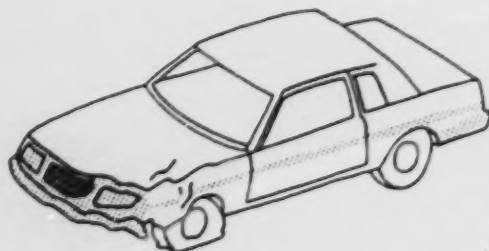
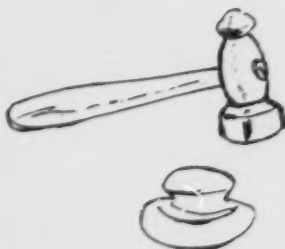
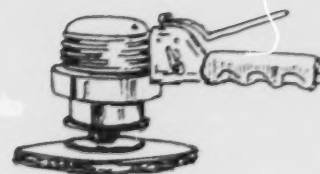
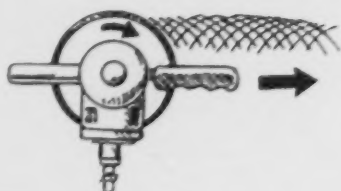
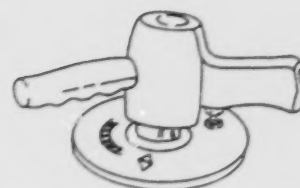
Satisfactory - Should move on ☐

Repeat this unit ☐

Student's Signature/Date

Instructor's Signature/Date

WELDING



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

WELDING

INTRODUCTION

In an auto body shop you use welding to bend, cut or join pieces of metal. You must know when and how to weld. Welding can be a dangerous process. You must closely follow safety rules and proper procedures.

UNIT OBJECTIVE

After completing this unit, you should be able to set up and use oxyacetylene and MIG welding units.

SPECIFIC OBJECTIVES

After completing this unit, when provided with the proper tools and equipment, you should be able to:

1. Define 14 terms associated with MIG and oxyacetylene welding.
2. Identify MIG and oxyacetylene auto body welding equipment.
3. Weld high-strength steel unibody structures.
4. Safely perform cutting operations with welding equipment.

Put a check beside the statement that is true for you.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



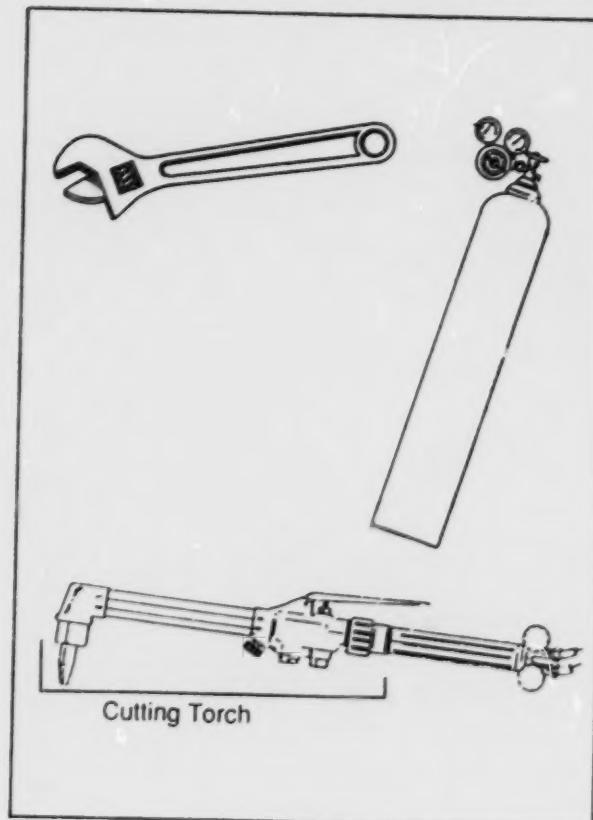
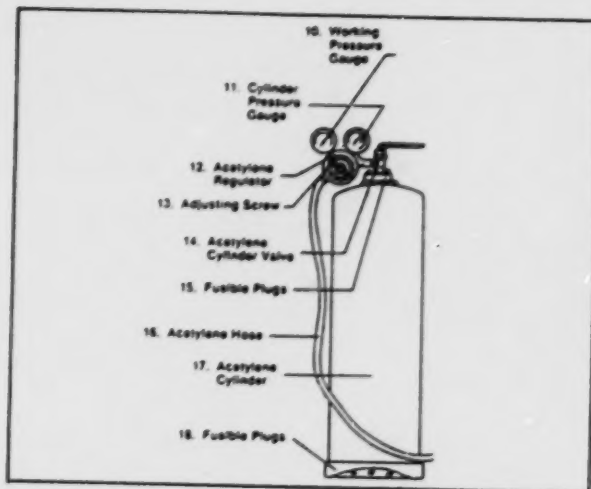
TURN PAGE AND BEGIN

A. TERMS

1. **Acetylene** - a colorless gas that smells like garlic used in oxyacetylene welding.
2. **Argon** - the shielding gas used in MIG welding.
3. **Bead** - the line of molten metal that joins two pieces of metal together.
4. **Clockwise** - the direction of movement for the hands on a clock.
5. **Counter-clockwise** - the direction opposite to that of the movement of the hands on a clock.
6. **Crack** - the process of opening and closing cylinder valves in order to blow dirt from the valve openings.
7. **MIG - Metallic Inert Gas**; MIG is the name of a welding process.
8. **Neutral flame** - the type of flame used for cutting.
9. **Oxyacetylene** - a type of welding in which oxygen and acetylene are mixed to form a flame.
10. **Oxygen** - a colorless, odorless gas used in oxyacetylene welding that makes burning possible.
11. **PSI - Pounds per Square Inch**. Pressure is measured in psi.
12. **Puddle** - a pool of molten metal.
13. **Purge** - the process of blowing gas through hoses to clean out dirt.
14. **Shielding gas** - a gas that protects the welding zone from impurities.

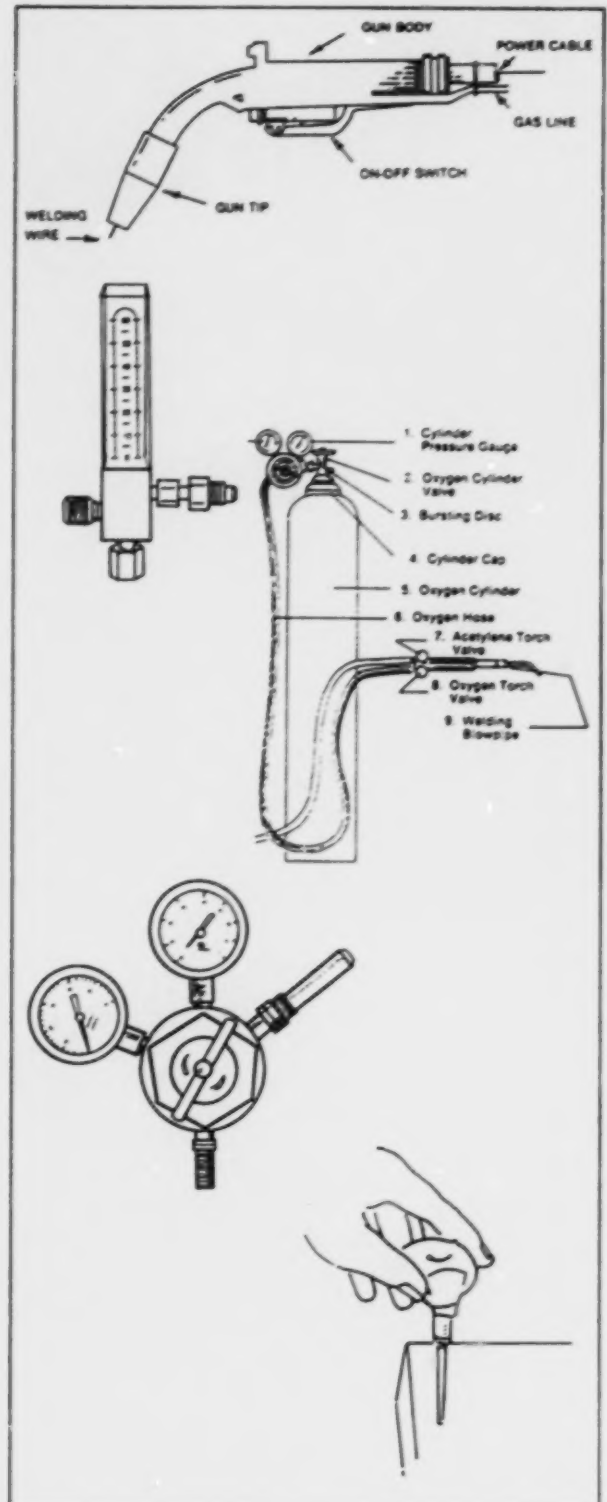
B. EQUIPMENT

1. **Acetylene cylinder** - usually a black tank used to store acetylene.
2. **Adjustable wrench** - a tool that tightens oxygen and acetylene fittings.
3. **Argon cylinder** - usually a brown tank used to store argon.
4. **Cutting torch** - a long tube attached to the torch body for cutting operations.



AUTO BODY WELDING

5. **Gun** - a part of the MIG welder that brings wire and gas to the welding zone.
6. **Flowmeter** - a gauge that measures the rate of gas flow.
7. **Oxygen cylinder** - usually a green tank that stores oxygen.
8. **Regulator** - a part that controls the flow of gas from the cylinders to make gas pressure constant.
9. **Scratch awl** - a tool used mark the cutting line on painted metal.

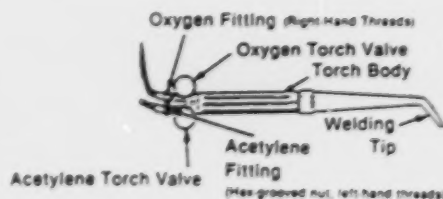


10. **Soapstone** - a type of talc used to mark the cutting line on painted or bare metal.

11. **Spark lighter** - a tool whose sides are squeezed together to create the spark used to light the welding torch.

12. **T-wrench** - a tool used to open and close the acetylene torch valve.

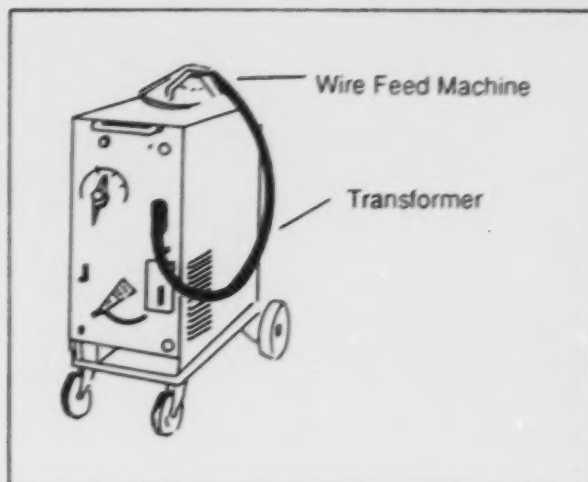
13. **Torch** - the tubed end, also called a "blowpipe," of the oxyacetylene welder in which the two gases mix.



AUTO BODY WELDING

14. **Transformer** - the power source for MIG welding.

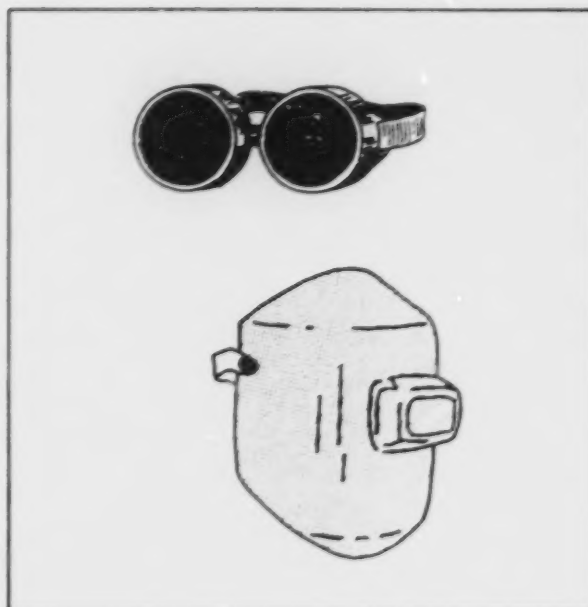
15. **Wire feed machine** - a machine that controls the speed of the wire being fed into the MIG gun.



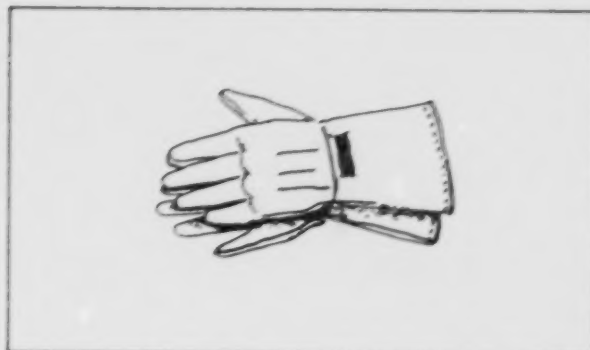
C. SAFETY EQUIPMENT

1. **Goggles** - tinted, closely fitting eye covers that protect the eyes from harmful rays, sparks and molten metal.

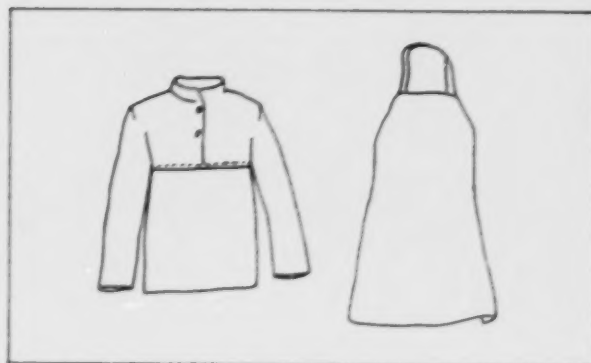
2. **Hood** - a shield you wear over your head and eyes for protection. Some hoods have flip-up lenses.



3. **Leather gloves** - a pair of hand covers with gauntlets to protect your hands and forearms from harmful rays, sparks and molten metal.



4. **Leather jackets and aprons** - body covers to protect your chest and lower body from harmful rays, sparks and molten metal.



5. **Safety glasses** - these protect your eyes. Do not wear steel-framed glasses when welding.

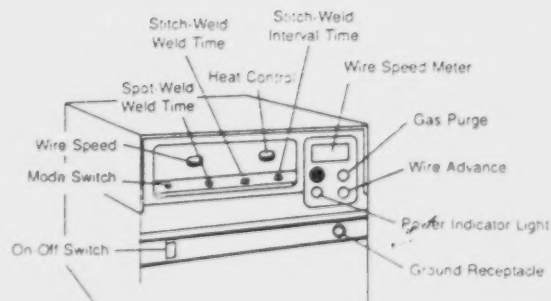
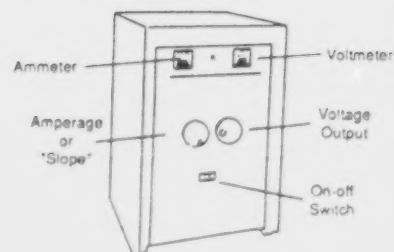


D. MIG WELDING EQUIPMENT

Metallic Inert Gas (MIG) welders, also called "wire welders," are used to join steel bodies, aluminum bodies and steel frames. Instead of a welding rod, the MIG welder uses wire. There are **four basic components** of a MIG welder:

1. transformer
2. gas
3. gun
4. wire feed

1. The **transformer**, which sometimes is called the "inverter" or "rectifier," is the power source for the welder. Not all transformers look alike. Some have storage areas on the inside that hold the wire. Larger units tend to be more expensive and perform more functions. One dial on the

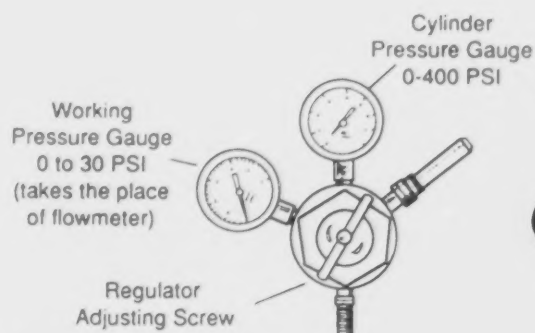
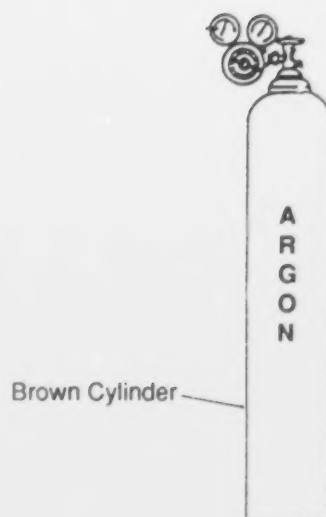


transformer controls voltage output. Another controls amperage. The power switch turns the machine off and on.

2. **Argon** is the most common gas used in the MIG welder, although others are used too. Argon is a "shielding gas," which means it protects the welding zone from impurities. Argon is usually stored in a brown cylinder. To keep it from falling, the cylinder is chained to the welding cart.

CAUTION: Cylinders are under high pressure and may explode when they fall.

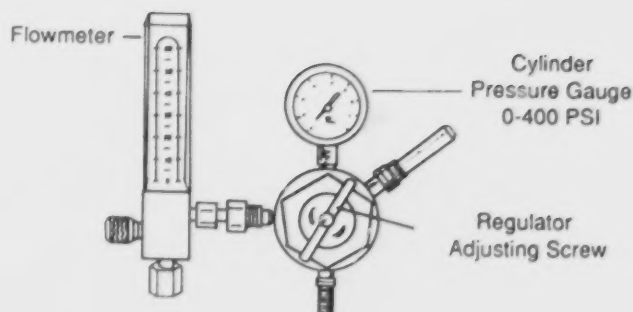
A **regulator**, attached to the cylinder, has a **gauge** that shows how much pressure is in the



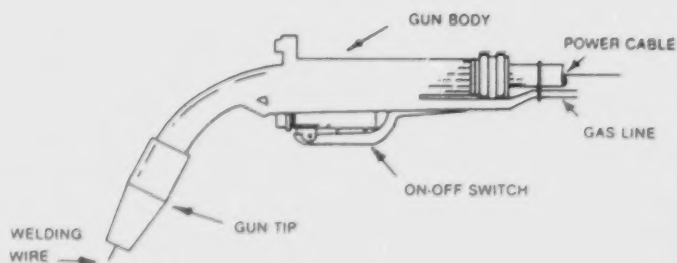
AUTO BODY WELDING

cylinder. The regulator keeps the pressure constant as the gas moves from the cylinder to the **flowmeter**, which measures how quickly the gas is leaving the cylinder.

When more gas flows from the cylinder, an indicator ball on the regulator moves up on the inside of the meter. A hose connected to the flowmeter carries the gas through a **solenoid** under the wire feeder and into the gun.

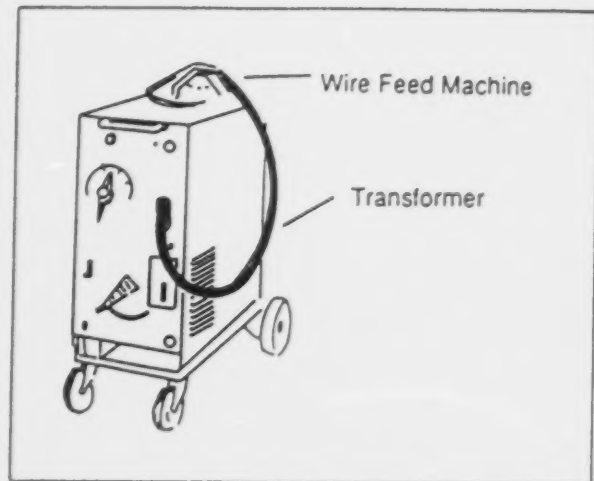


3. All MIG **guns** do not look alike. Different sizes of nozzles and tips are available. The gun you use depends on the job. A cable carries power from the transformer and wire from the wire feed machine to the gun.



The gun, held close to the metal when you weld, delivers the gas and wire to the welding zone. A trigger controls the wire and gas being fed into the gun. When you pull the trigger, wire comes out. When you release the trigger, the wire and gas stop coming out.

4. The **wire feed machine**, usually located on top of the transformer, controls the speed at which the wire is fed to the gun. The wire is housed on a reel, which may be located on the welding cart or inside the transformer. The wire feed machine feeds wire into the cable, which carries it to the gun. The wire then comes out at the tip of the gun. A dial on the wire feed machine, or sometimes on the transformer, controls the speed at



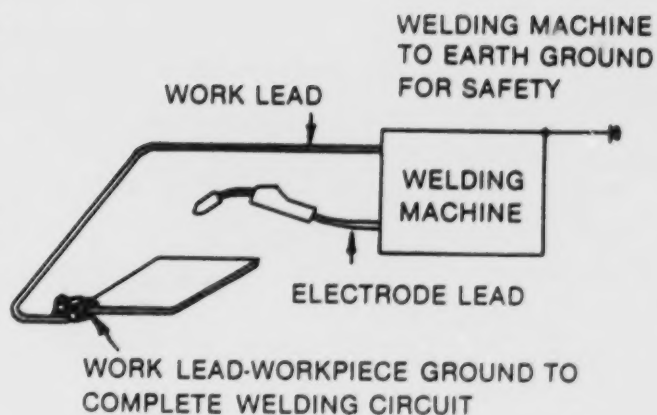
which wire is fed to the gun. There is also a switch for turning the machine on and off.

E. MIG WELDING SAFETY RULES

1. NEVER use the welder near water because it uses electricity. NEVER dip the welding gun in water to cool it.

2. ALWAYS keep the work area, the equipment, your clothing and the electrical connections dry and clean. Poor or loose connections can heat up, spark, cause bad welds, make dangerous arcs or even melt.

3. ALWAYS be sure welding equipment is grounded to earth. (Do not confuse this ground with the work lead to workpiece ground that completes the welding circuit.)



4. NEVER wear pants with cuffs. Cuffs can trap sparks, which will burn your legs, feet or ankles. Button your shirt sleeves and collar to provide extra protection against sparks. Besides molten metal and sparks, the welding arc creates dangerous rays that can severely burn the eyes and skin.

5. ALWAYS wear protective equipment: a proper hood, leather welding gloves with gauntlets and impact-resistant safety glasses with side shields. Wear boots or leather shoes, NOT TENNIS SHOES. When working in a cramped space, wear a leather jacket or apron.



6. ALWAYS wear a respirator if you are welding in a confined area.

CAUTION: ARGON IS MUCH HEAVIER THAN AIR AND QUICKLY DISPLACES OXYGEN.

When the air in the room is gone, you suffocate.



7. ALWAYS weld in well-ventilated areas because toxic fumes are often produced. ALWAYS position your head to the side of rising fumes.

8. ALWAYS keep welding cables as close to the work area as possible. NEVER connect cables to the building framework. Current can travel through lifting chains and cables and can weaken them. NEVER drag cables or hoses

through dirt or oil. NEVER pull on a cable. ALWAYS keep cables and hoses coiled and free of kinks. ALWAYS use clean, dry rags to clean cables and hoses. NEVER use gasoline or an oily rag.

9. NEVER drape a welding cable over any type of gas cylinder. NEVER strike an arc on a gas cylinder. NEVER weld near flammable substances. ALWAYS make sure you have the right spool or coil before loading and cutting tie wires.

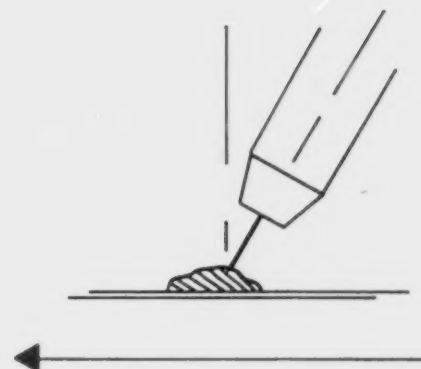


10. NEVER look into a welding gun while feeding wire through it. NEVER point the gun at someone else. NEVER place a finger or hand over a contact tip to see if the wire is feeding properly.

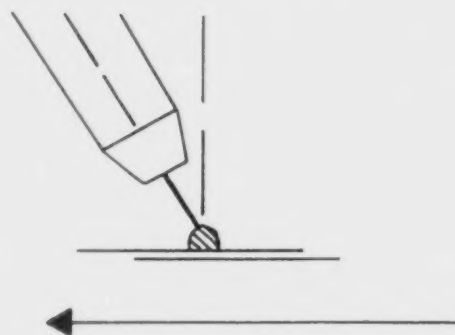
F. MIG WELDING TECHNIQUES

There are two main techniques when using a MIG welder:

1. The **push** technique is used on heavier metal. You hold the nozzle at an angle of 5 to 15 degrees from the workpiece. The wire points forward and "pushes" the new weld ahead.



2. The **pull** technique is used on lighter metal and is the more common method in the auto body shop. You hold the nozzle at an angle of 5 to 15 degrees from the workpiece. The wire points backward and "pulls" the new weld along. This technique usually makes a high narrow bead.



The gun's angle is very important. If the angle is greater than 25 degrees, the penetration (depth of the weld) will not be good. When the angle is decreased in the pull technique, the bead becomes wider and shorter.

G. STEPS IN MIG WELDING

1. Equipment:

MIG welding machine with accessories
Personal safety clothing and equipment
Argon

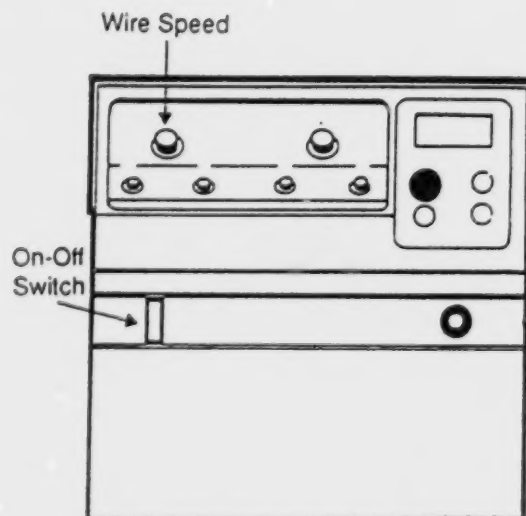
Wire to specification

Work piece

2. Put on your safety glasses.

3. Plug in the transformer or inverter.

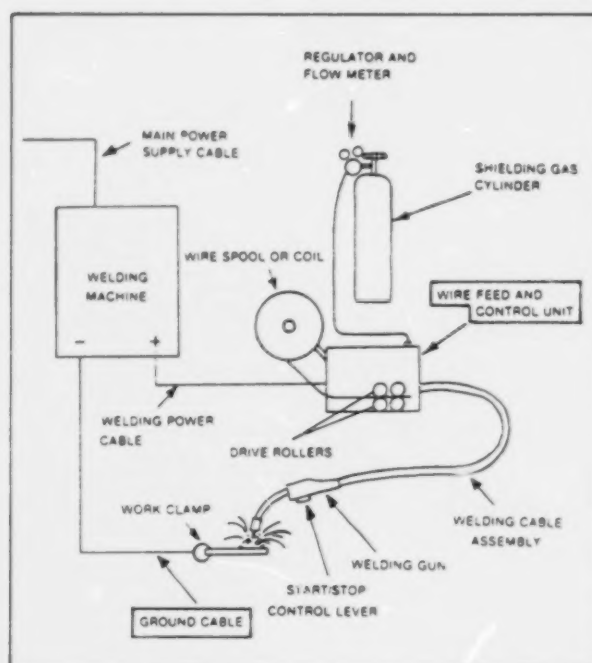
4. Turn on the power source.



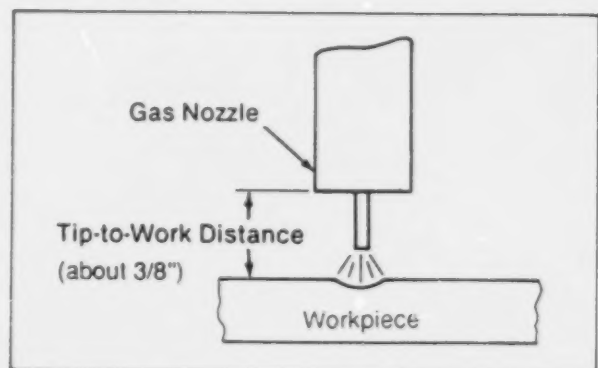
5. Set the wire-feed speed control at zero (0).
6. Turn on the wire feed machine.
7. Slowly open the valve on top of the argon cylinder by turning it counter-clockwise.



8. Watch the gauge as you turn. When the needle stops moving, open the valve completely.
9. Pull the gun's trigger, then open the flowmeter valve slowly.
10. Adjust the flowmeter to the rate you need.

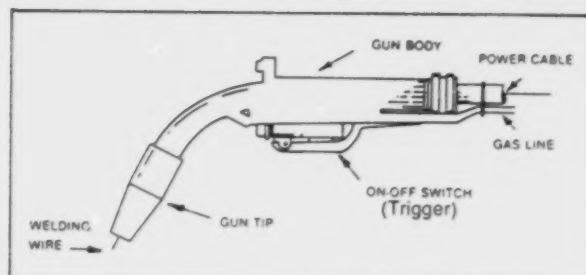


11. Adjust the wire feed speed control to help determine the current.
12. Attach the ground cable to the workpiece.
13. Adjust the voltage on the transformer.
14. Adjust the amperage on the transformer.
15. Put on the helmet and gloves.
16. Put gun nozzle about $\frac{3}{8}$ of an inch from the workpiece. Hold it at an angle of 5 to 15 degrees.



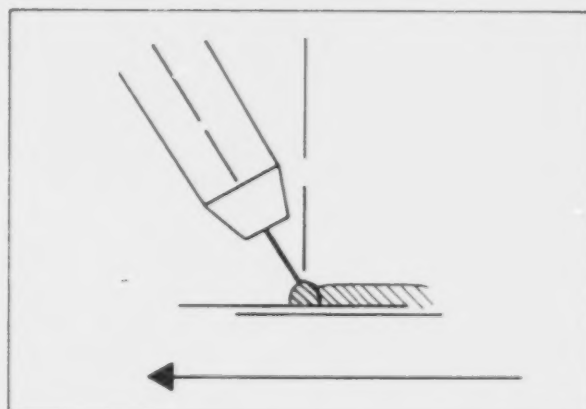
AUTO BODY WELDING

17. Pull the trigger to create an arc. To break the arc, release the trigger.

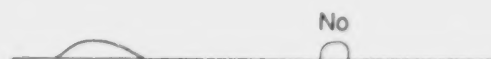


18. Run a test bead on a piece of scrap metal. Listen for a frying sound. Adjust the voltage, amperage or wire feed if you hear this sound.

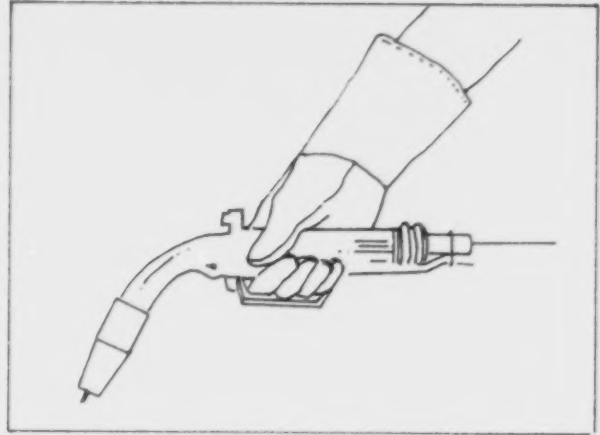
19. Use the pull technique to make a bead. Point the wire in the opposite direction of the weld, and pull the molten metal toward you.



20. Look at the bead. Its edges should blend into the base-plate material. The width of the bead should be the same all along the length.



21. Shut off the wire speed control. Set the dial on zero.
22. Pull the trigger to release gas pressure.
23. Let flowmeter's ball return to zero.
24. Turn off feed control switch.
25. Turn off the transformer.
26. Set the voltage at zero.
27. Unplug the transformer.
28. Store the equipment in a safe place.



DO SKILL SHEET 1

DO ACTIVITY SHEET 1

122

WELDING
SKILL SHEET 1

Directions: Using the words below, fill in the blanks. Not all the words will be used.

Oxygen	Transformer	Acetylene	Argon	Hose
Cable	Flowmeter	Regulator	Gun	

1. An example of a shielding gas is _____.
2. The power source for the MIG welder is called the _____.
3. _____ measures how quickly the gas is leaving the cylinder.
4. A _____ keeps pressure constant.
5. The _____ delivers gas and wire to the welding zone.

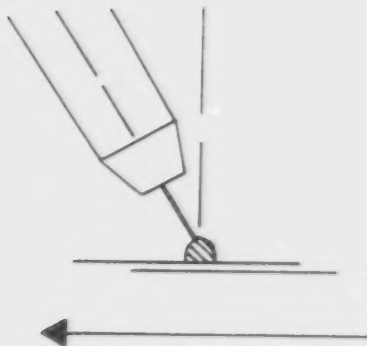
Directions: Mark a "T" beside each true statement and an "F" beside each false statement.

- _____ 6. It is best to cool the gun by dipping it in water.
- _____ 7. A hood should be worn to protect eyes and skin.
- _____ 8. It is safe to wear tennis shoes when welding.
- _____ 9. It is unsafe to weld near paint thinners.
- _____ 10. It is safest to hold your head to the side of rising fumes.
- _____ 11. It is unsafe to point the welding gun at someone.

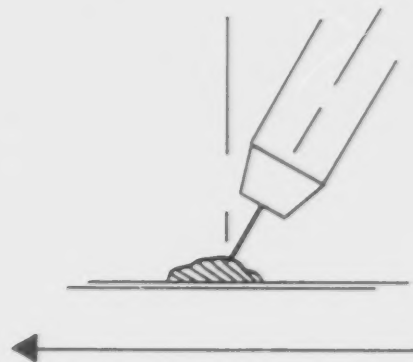
- ___ 12. It is safe to place your finger over the end of the gun to see if the wire is coming out.
- ___ 13. A ground wire should be attached to the workpiece.
- ___ 14. The gun should be held at a 30 - 35 degree angle to the workpiece.
- ___ 15. If a frying sound is heard, adjustments should be made.
- ___ 16. The wire feed control is set at 10 after the power source is plugged in.
- ___ 17. The pull technique is used on heavier metal.
- ___ 18. The push technique is used on heavier metal.

Directions: Identify the technique being used.

19.



20.



WELDING

ACTIVITY SHEET 1

Equipment:

MIG machine with accessories

Personal safety clothing and equipment

Wire to specifications

Workpiece

Argon

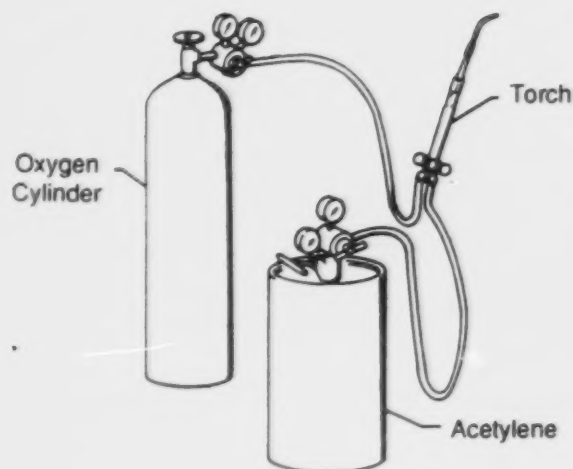
Evaluation

	3	2	1	N
1. Put on safety glasses.	—	—	—	—
2. Connect power source.	—	—	—	—
3. Set wire feed machine and turn on.	—	—	—	—
4. Open argon cylinder.	—	—	—	—
5. Open flowmeter and set gauge.	—	—	—	—
6. Adjust wire speed.	—	—	—	—
7. Attach ground wire.	—	—	—	—
8. Adjust voltage and amperage.	—	—	—	—
9. Put on safety equipment.	—	—	—	—
10. Demonstrate correct angle.	—	—	—	—
11. Run test bead.	—	—	—	—
12. Adjust, if necessary.	—	—	—	—
13. Use pull technique correctly.	—	—	—	—
14. Inspect weld.	—	—	—	—
15. Shut down equipment properly.	—	—	—	—

H. OXYACETYLENE WELDING EQUIPMENT

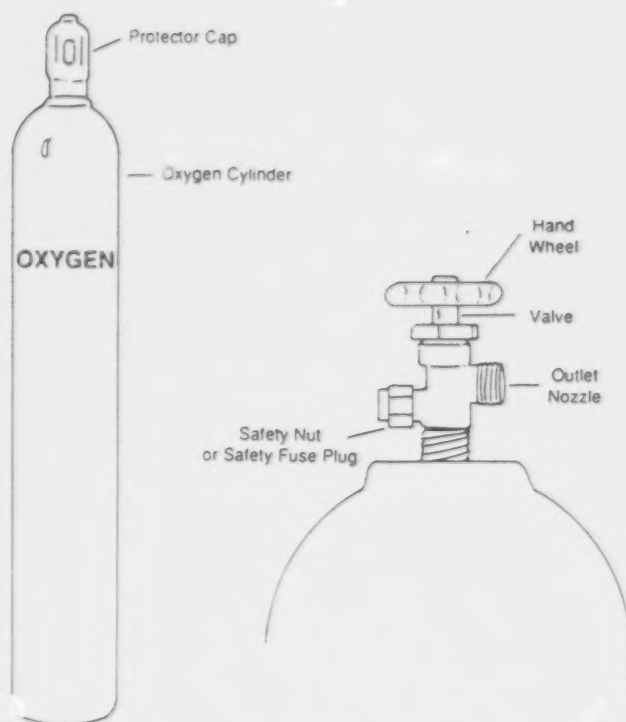
An oxyacetylene welder has three major parts:

1. oxygen
2. acetylene
3. torch



1. **The oxygen system** consists of the **cylinder**, the **hose** and the **regulator**. Oxygen is a gas with no color, odor or taste. Oxygen by itself will not burn, but it will help another gas burn.

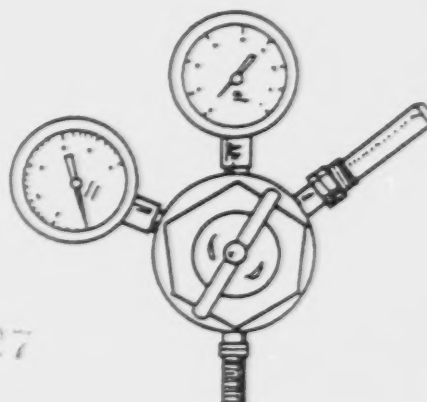
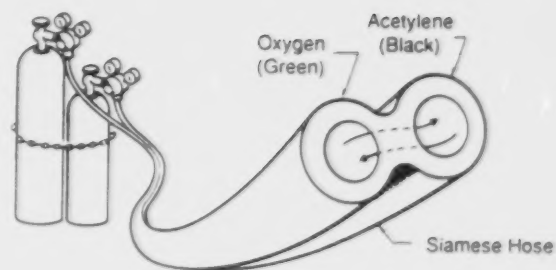
Oxygen cylinders, usually green, have a high pressure valve, which you open by turning the hand wheel on top of the cylinder. Turn the hand wheel **SLOWLY** to permit a gradual pressure load on the regulator.



The protector cap should always be in place when cylinders are not in use. Oxygen is under a great deal of pressure in the cylinder. As the temperature of the oxygen in the cylinder increases, the pressure increases. If the pressure of the gas gets too high, a safety nut or safety plug and disc, located in the cylinder valve, can release the pressure.

The oxygen **hose**, also usually green, carries oxygen from the regulator to the torch body.

The **regulator** lowers the cylinder pressure to the needed working pressure and produces a steady flow of gas under varying cylinder pressures. Regulators are very

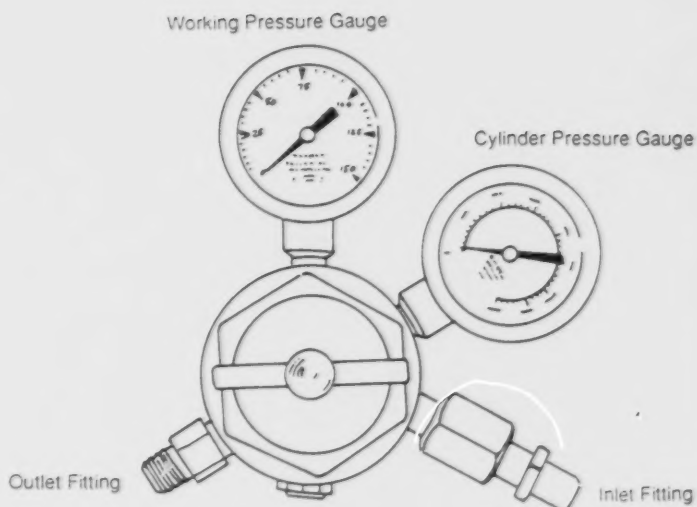


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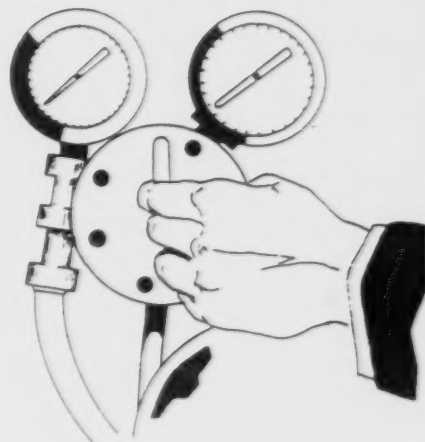
sensitive. Be very careful when handling the regulator because a small bump or jar can put a regulator out of order.

Regulators have two gauges: (1) the **cylinder pressure gauge** and (2) the **working pressure gauge**.

The cylinder pressure gauge shows the actual pressure in the cylinder. The working pressure gauge shows the working or line pressure.



It's very important when you use a regulator to remember to release (turn out) the adjusting screw before you open the cylinder valve. If the adjusting screw is not released and the cylinder valve is opened, the tremendous pressure of the gas in the cylinder is forced



on the working pressure gauge and will probably break the regulator.

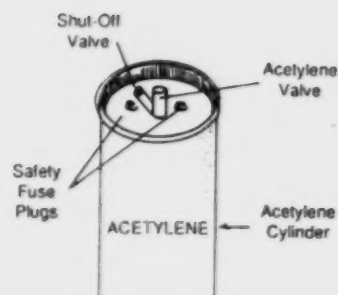
2. **Acetylene gas** smells like garlic and is mixed with oxygen to make the hottest known flame. Acetylene cylinders and hoses are usually black. You use a T-wrench on the cylinder valve to turn the cylinder on and off. The cylinder valve should never be opened more than 1/2 turn. A small opening allows the valve to be closed in a hurry in an emergency.

Acetylene cylinders have safety plugs made of a metal that melts at a low temperature. A large amount of heat would make the gas in the cylinder reach a dangerously high level of pressure. If this were to happen, the heat

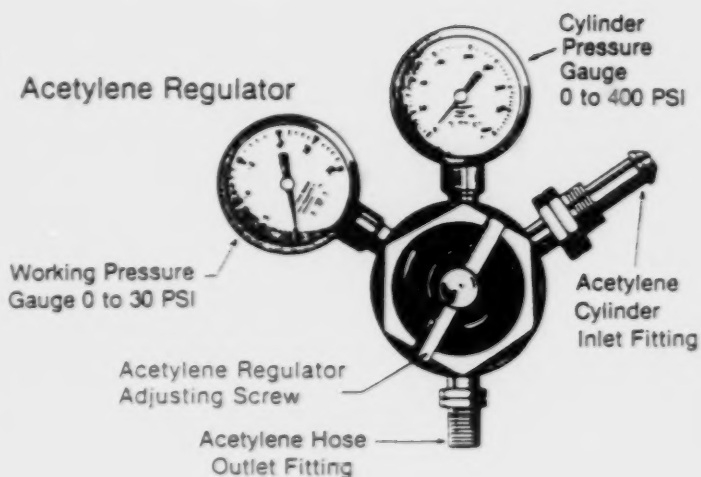


would melt the plugs and let the acetylene escape, preventing an explosion.

Some cylinders, such as the one at the right, do not have protector caps. The valves are protected by the lip of the tank. Other cylinders have protective caps to cover the valve.



The acetylene regulator has the same function as the oxygen regulator. Both lower the cylinder pressure to the needed working pressure and steady the flow of gas. Like the oxygen regulator, the acetylene regulator has two gauges: a (1) **cylinder pressure gauge**, which shows the actual pressure in the cylinder, and a (2) **working pressure gauge**, which

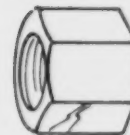


shows the working or line pressure.

The main difference between oxygen regulators and acetylene regulators is in their fittings.

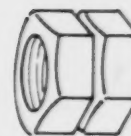
Oxygen regulators have right-hand threads and acetylene regulators have left-hand threads to prevent attaching the wrong hose to a regulator.

Oxygen



Right-Hand Threads

Acetylene

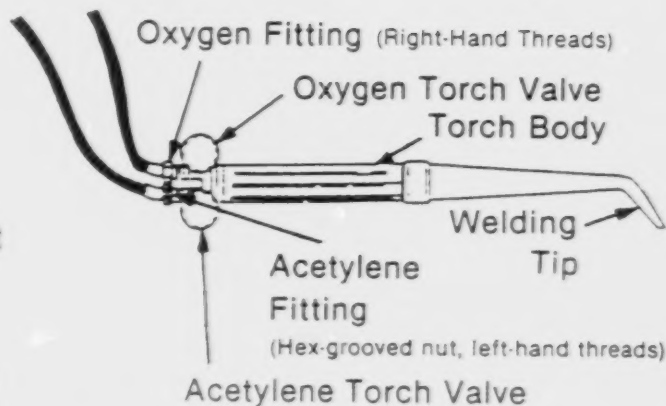


Left-Hand Threads

3. The torch, or "blowpipe," is a tool that mixes oxygen and acetylene and controls the flow of gases to the end of its tip.

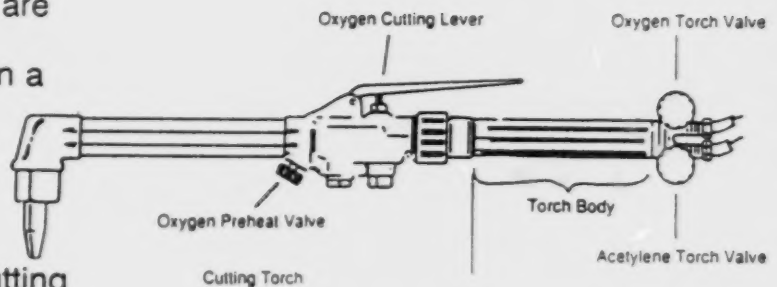
Torches have two needle (torch) valves: (1) one that controls the flow of oxygen and (2) another that controls the flow of acetylene.

Two fittings at the rear of the torch connect the hoses to the torch.



The oxygen fitting has right-handed threads and the acetylene fitting has left-handed threads to prevent attaching the wrong hose to a fitting.

The **cutting torch** connects to the torch body. You use it to cut metal. Oxygen and acetylene are mixed in the proper amounts in a chamber of the cutting torch.



There are two valves on the cutting torch: (1) **The preheat oxygen valve** adjusts the flow of oxygen during the preheating stage of cutting. (The metal must be heated before cutting can begin.) (2) **The cutting oxygen valve** is a lever you squeeze to let more oxygen out during the cutting process.

I. SAFETY RULES FOR OXYACETYLENE WELDERS

1. NEVER use gas cylinders unless the contents are clearly marked. NEVER operate equipment without instruction on its use.

2. ALWAYS wear goggles and other protective clothing when lighting a torch, cutting or welding.

3. ALWAYS avoid breathing the fumes when welding painted objects.

4. NEVER use pipe fitting compounds on oxygen connections.

5. NEVER use hoses that are not made for welding.



6. NEVER force connections that do not fit. NEVER work with defective equipment. ALWAYS check the condition of the hoses on the torch for leaks. If you find a leak, report it **immediately**. NEVER use leaky hoses.

7. ALWAYS turn the pressure adjusting screw (to the left) before opening the cylinder. Leave the T-wrench on the acetylene cylinder.

8. NEVER operate the oxygen cylinder or regulator while wearing oily or greasy gloves. When oil and oxygen mix, an explosion may occur.



9. ALWAYS stand to the opposite side of the regulator when opening the cylinder valve.

10. NEVER release acetylene into the air when welding is being done in the area.

11. NEVER light any kind of fire around oxygen and acetylene cylinders. Know the location of fire extinguishers and how to use them.

12. NEVER lay a lighted torch down. ALWAYS keep a lighted torch where you can see it. NEVER point the torch at another person. ALWAYS, before lighting a torch, be sure it is not pointing at you, other people, hoses or regulators; point its tip downward



or toward the top of the bench.

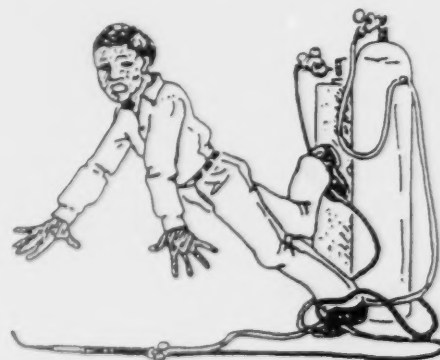
ALWAYS be sure the flame will not come in contact with flammable material.

13. ALWAYS, before you touch a piece of metal, hold your hand close to it first to see if the metal is hot. If you do get a burn, no matter how small, **report** it.

14. NEVER light a welding torch with a match. You can burn yourself in the process. ALWAYS use a sparklighter to light the torch.



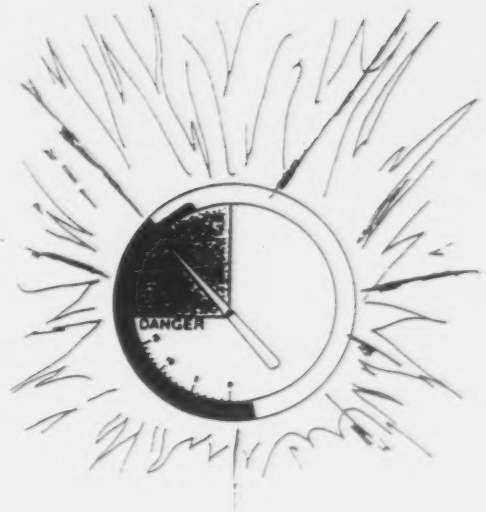
15. ALWAYS fasten cylinders securely so they cannot fall. ALWAYS coil the hoses after welding to prevent tripping and falling.



16. NEVER use oxygen under high pressure without an oxygen regulator.

17. ALWAYS use an acetylene pressure reducing regulator. NEVER exceed 15 pounds per square inch (psi) on the acetylene working gauge.

18. ALWAYS set the acetylene working pressure to match torch tip size and metal thickness.



J. STEPS IN OXYACETYLENE CUTTING

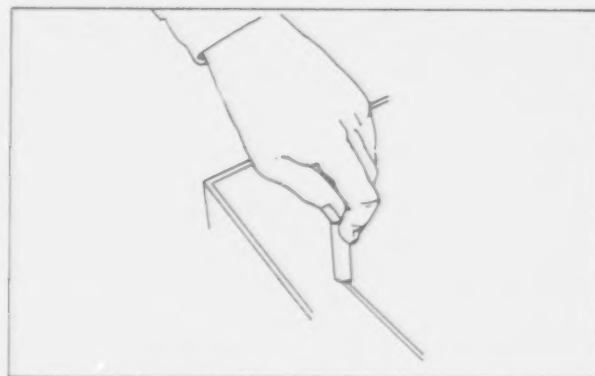
1. Equipment:

Adjustable wrench	T-wrench	Welding hoses
Regulators	Torch body	Sparklighter
Cylinders	Torch tip	Soapstone
Non-petroleum soap	Bottle or dish of water	
Protective equipment and clothing		

2. Using the soapstone or awl, draw a cutting line.

3. Put on safety glasses.

4. Mix a solution of soap and water in a dish or bottle.



CAUTION: Do not use an oil-based soap. Oil and oxygen can cause a violent explosion.

5. Check the equipment
(welding hoses, fittings,
nozzle threads, cylinders and
torch tips).

A. The welding hoses
should have no visible holes
and should not look worn.

B. The fittings should be
clean.

C. The nozzle threads
should not look worn.

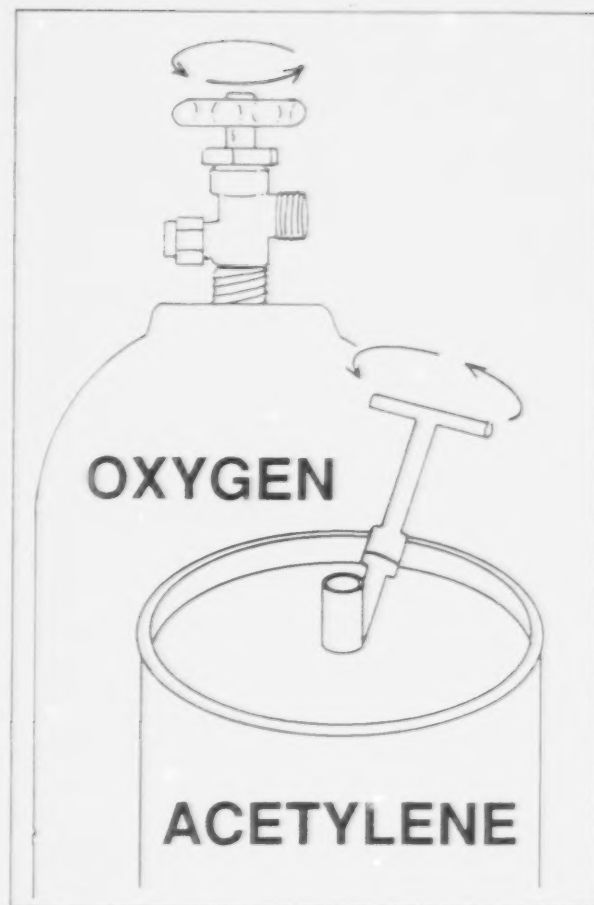
D. The cylinders should
be chained to the cart.

E. Keep torch tips clean.



6. Remove the oxygen cylinder protector cap and put it in the tray of the cart.
7. "Crack" the cylinder valves by: A. turning the oxygen valve counter-clockwise to open it and then clockwise to close it, B. turning the T-wrench on the acetylene cylinder valve counterclockwise and then clockwise to close it. Leave the T-wrench on the cylinder valve.

CAUTION: Do not crack the valves near a flame. Never open the acetylene cylinder valve more than 1/2 turn. If a fire breaks out, you can close a small opening quickly. Stand to the side of the

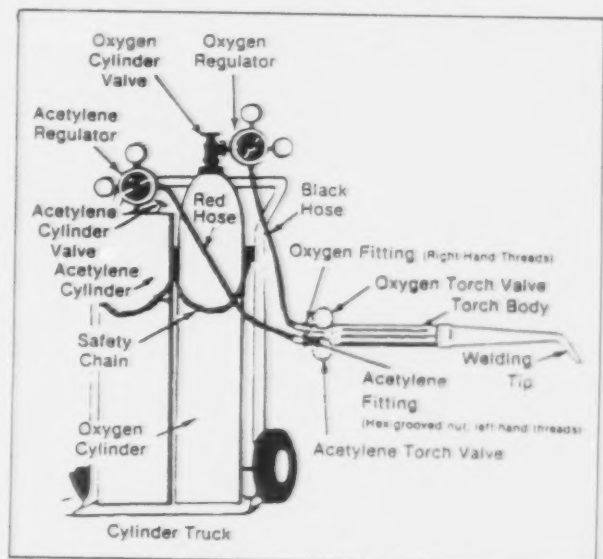
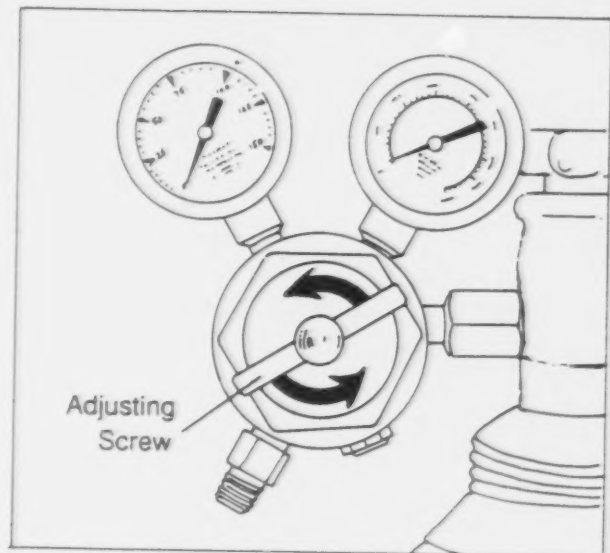
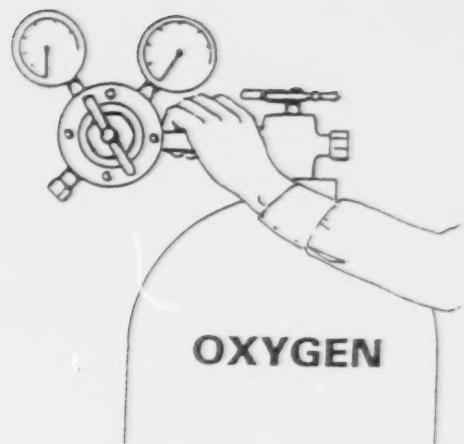


cylinder; make sure no one else is in front of the cylinder.

8. Attach the regulators to the cylinders, tightening them with your fingers and then with the adjustable wrench.
9. Purge the regulators by turning the oxygen regulator adjusting screws counterclockwise and then clockwise.

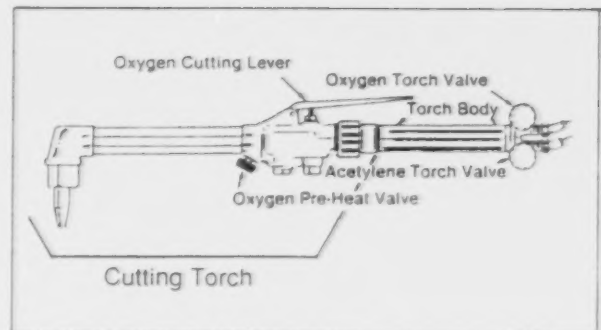
NOTE: Open the regulators only enough to blow dirt from the nozzles.

10. Attach the welding hoses to the regulators. The oxygen hose is green. The acetylene hose is red.



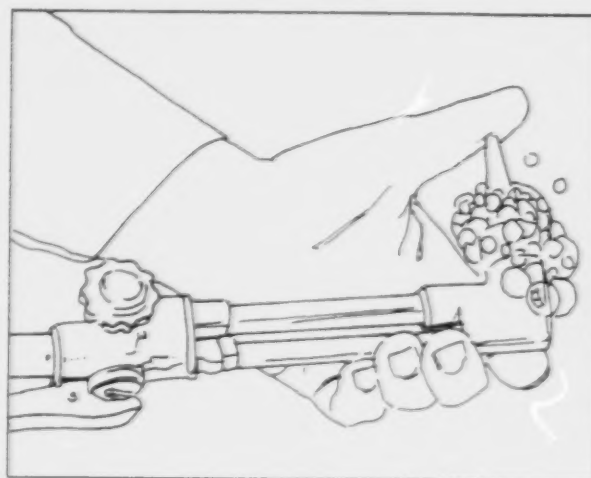
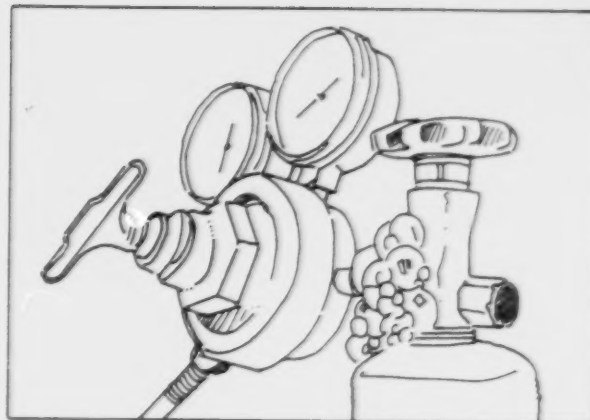
11. Attach the ends of the hoses to the torch body. Be sure the oxygen hose is attached to the oxygen valve and the acetylene hose to the acetylene valve.

12. Attach the cutting torch to the torch body.



13. Attach the tip to the cutting torch.
14. Purge the lines by opening and closing the regulators (see step 7).
15. Check for leaks. Open the regulator slightly and squirt the soap solution on the:

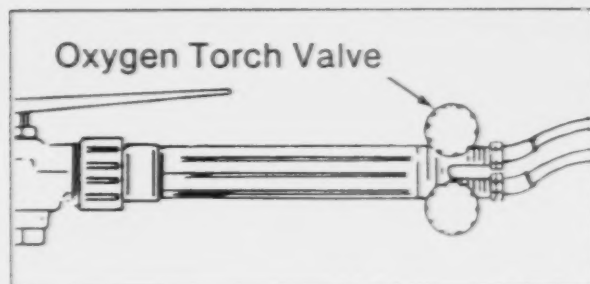
- A. oxygen and acetylene regulator connections,
- B. oxygen and acetylene hose connections at the regulator,
- C. oxygen and acetylene hose connections at the torch body,
- D. oxygen and acetylene torch valves.



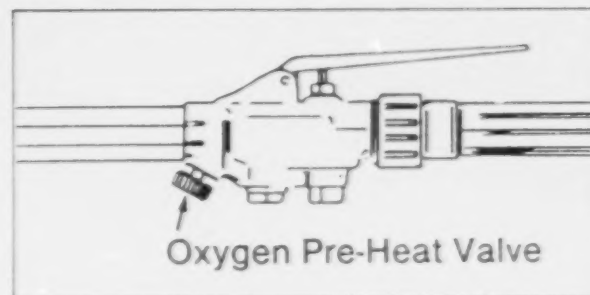
CAUTION: If you see a bubble, which means a leak, shut off the regulator and show your instructor.

16. Set the pressure on the oxygen and acetylene regulators. The pressure depends on the tip and metal being used.

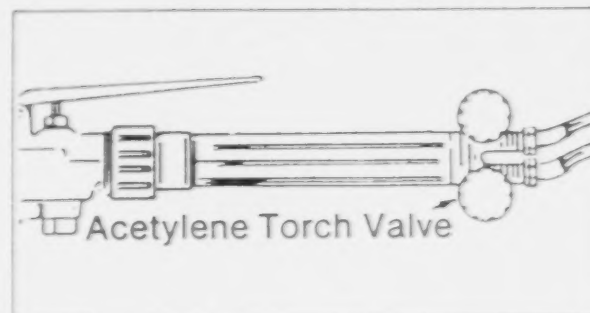
17. Open the oxygen torch valve completely. Make sure the pre-heat oxygen valve is off.



18. Open the pre-heat oxygen valve slightly. Turn the adjusting screw to adjust the oxygen regulator until the right amount of pressure is set.



19. Open the acetylene torch valve slightly.

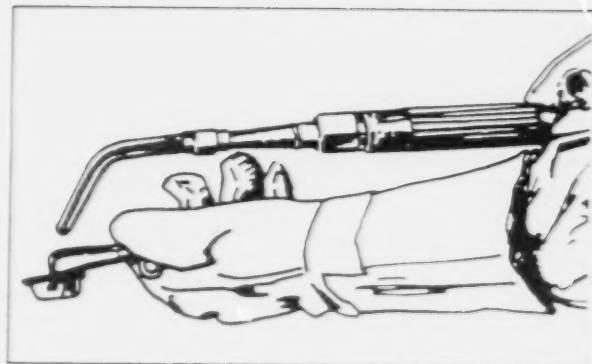


20. Adjust the regulator by turning the adjusting screw until the right amount of pressure is set.
21. Close the acetylene torch valve.

22. Put on protective clothing.
23. Make sure the pre-heat oxygen control valve on the torch is off.
24. Open the acetylene torch valve 1/2 turn.

CAUTION: Point the torch away from people, cylinders, flammables, etc.

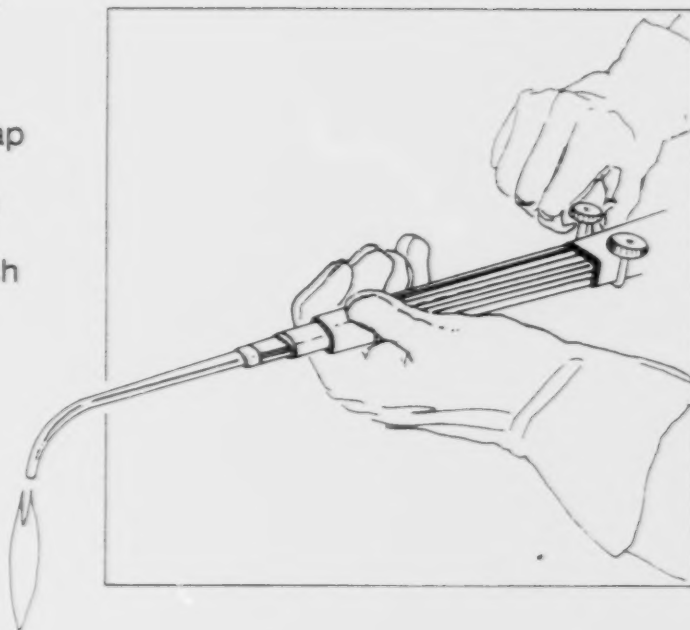
25. Light the torch by holding the sparklighter about 1 inch from the torch top and "striking an arc."



CAUTION: If the gas does not ignite within a few seconds, turn it off. The gas may pocket and explode.

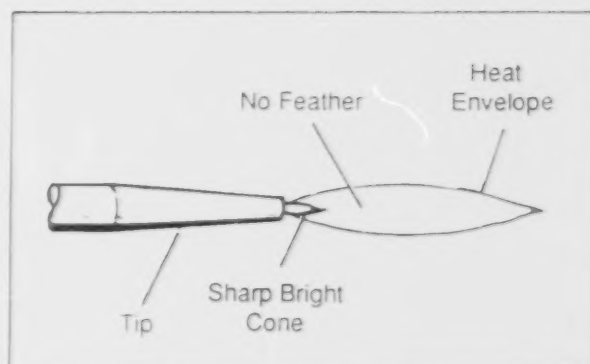
26. Keep opening the acetylene torch valve until the flame stops smoking excessively.

27. When the flame leaves a gap of about $\frac{1}{8}$ inch from the tip, close the acetylene torch valve slightly to bring the flame back.



28. Slowly open the oxygen torch valve until it is completely on.

29. Slowly open the pre-heat oxygen control valve. Open this valve until the feathery edges of the flame disappear. You should see a sharp inner cone. This is called a neutral flame. It

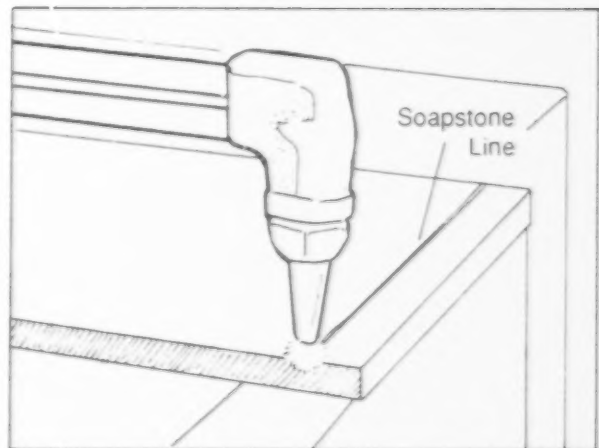


must not have either too much oxygen or too much acetylene. The cutting flame is about 6,300 degrees F.

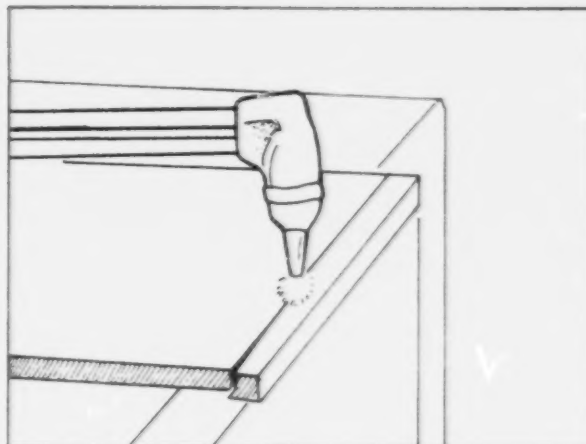
30. Pull the oxygen lever on the cutting torch. Adjust the pre-heat oxygen valve, if necessary.

NOTE: Keep the lever depressed while adjusting the flame.

31. Hold the blue inner cone of the flame about 1/8 inch from the end of the cutting line. The pre-heat spot will become cherry red.



32. Holding the tip at a 90-degree angle to the workpiece, slowly squeeze the torch lever to release more oxygen as you cut. Move the tip steadily along the soapstone line.



33. When the cut is finished, close the acetylene torch valve.
34. Close the oxygen valve.
35. Close both cylinder valves.
36. Open the torch valves again to relieve the left-over pressure.
37. Pull the oxygen lever on the torch.

38. Turn the regulator screws out to release pressure on the regulator.
39. Close the torch valves again.
40. Coil the hoses; put them on the cart.

DO SKILL SHEET 2

DO ACTIVITY SHEET 2

149

WELDING
SKILL SHEET 2

Directions: Use these words to fill in the blanks and complete the sentences below.

Soapstone/awl	Green	Needle valves	Oxygen
T-wrench	Black	Cutting torch	Acetylene
Regulators	Pre-heat		

1. Oxygen cylinders are usually _____ in color.
2. Acetylene cylinders are usually _____ in color.
3. _____ is a gas with no color, odor or taste.
4. _____ gas smells like garlic.
5. _____ ensure a constant working pressure.
6. The oxygen and acetylene are mixed in the _____.
7. Two _____ on the torch body control the flow of oxygen and acetylene.
8. The _____ oxygen valve controls the flow of oxygen.
9. A _____ is used to close and open the acetylene cylinder valve.
10. A(n) _____ is used to make a cutting line.

Directions: Mark a "T" if statement is true and an "F" if statement is false.

- ___ 11. A solution of soap and water is used to check for leaks.
- ___ 12. A non-petroleum-based soap must be used to check for leaks.
- ___ 13. Cylinder valves should not be "cracked" near flammables.
- ___ 14. To check for leaks, use a soap solution.
- ___ 15. The blue inner cone of the pre-heat flame is held one inch from the cutting line.
- ___ 16. The oxygen torch valve is closed during cutting operations.
- ___ 17. The acetylene cylinder valve is opened two turns with a T-wrench.
- ___ 18. The T-wrench is returned to the cart after the cylinder valve is opened.
- ___ 19. The cutting torch lever is squeezed to release extra oxygen during the cutting process.
- ___ 20. A neutral flame is used for cutting.

WELDING

ACTIVITY SHEET 2

Directions: Using an oxyacetylene welder, perform a cutting job.

Equipment:

Oxygen cylinder	Acetylene cylinder
Oxygen regulator	Acetylene regulator
Hoses	Welding torch
Friction lighter	Protective clothing and equipment

		Evaluation			
		3	2	1	N
1.	Put on safety glasses.	___	___	___	___
2.	Draw cutting line.	___	___	___	___
3.	Check equipment for damages.	___	___	___	___
4.	Set up equipment properly.	___	___	___	___
5.	Purge lines/cracked valves.	___	___	___	___
6.	Check for leaks.	___	___	___	___
7.	Light torch appropriately.	___	___	___	___
8.	Make necessary adjustments.	___	___	___	___
9.	Perform cutting operation correctly.	___	___	___	___
10.	Shut down equipment correctly.	___	___	___	___

WELDING
UNIT TEST

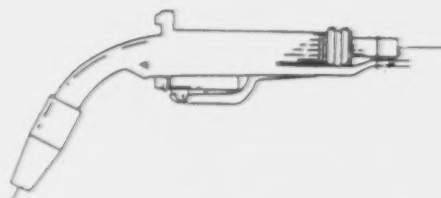
Directions: Match each number with a letter.

- | | | |
|----------|---|--------------|
| _____ 1. | Type of flame used for cutting. | A. Acetylene |
| _____ 2. | Pool of molten metal. | B. Argon |
| _____ 3. | Process of opening and closing cylinder valves to remove dirt. | C. Neutral |
| | | D. Puddle |
| | | E. Purge |
| | | F. Crack |
| | | G. Oxygen |
| _____ 4. | Process of blowing gas through working lines and hoses to dirt. | |
| _____ 5. | Colorless, odorless gas that makes burning possible. | |
| _____ 6. | Shielding gas used for MIG welding. | |
| _____ 7. | Colorless gas that smells like garlic. | |

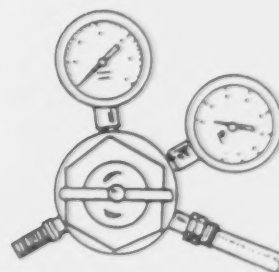
- _____ 8. Type of welding that mixes oxygen and acetylene to form a flame.
- _____ 9. Metallic Inert Gas.
- _____ 10. Gas that protects the welding zone.
- _____ 11. Pounds per square inch.
- _____ 12. Direction the clock's hands move.
- _____ 13. Opposite direction from that of the hands on the clock.
- _____ 14. The line of molten metal that joins two pieces of metal together.
- A. Oxyacetylene
B. Bead
C. Clockwise
D. PSI
E. Counter-clockwise
F. MIG
G. Shielding

Directions: Identify the following pieces of equipment and/or their parts.

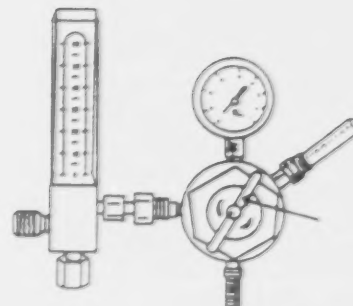
15. _____



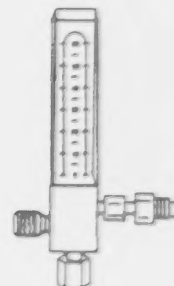
16. _____



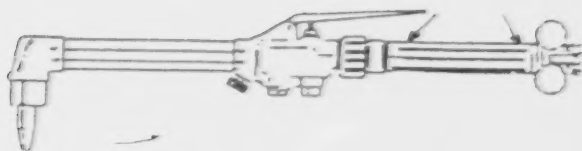
17. _____



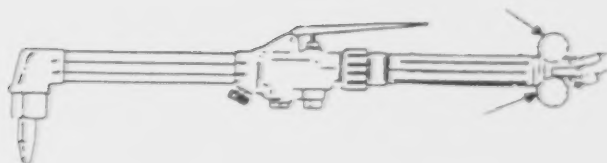
18. _____



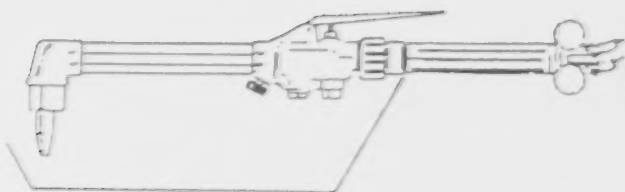
19. _____



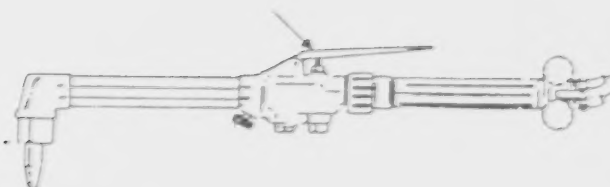
20. _____



21. _____



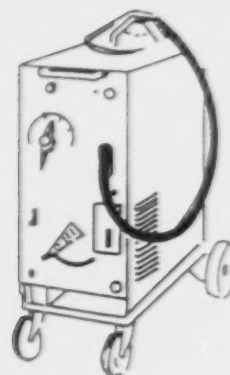
22. _____



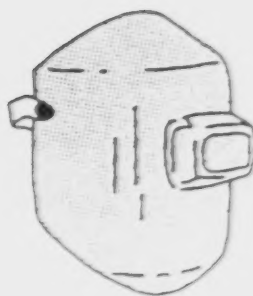
23. _____



24. _____



25. _____



26. _____



27. _____



WELDING

PERFORMANCE CHECKLIST

Student _____ has successfully
performed the following tasks:

	YES	NO	COMMENTS
1. Defined 14 terms associated with MIG and oxyacetylene welding.			
2. Identified MIG and oxyacetylene welding equipment.			
3. Welded high-strength steel unibody structures.			
4. Safely performed cutting operations with welding equipment.			

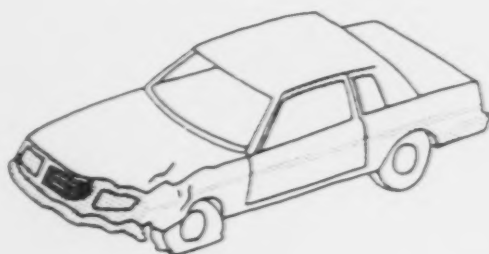
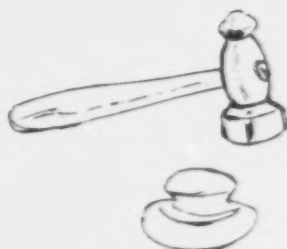
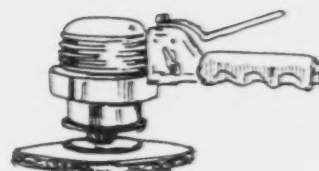
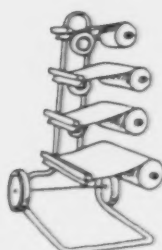
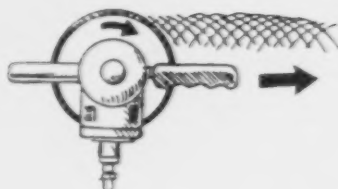
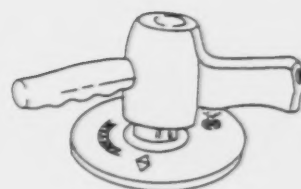
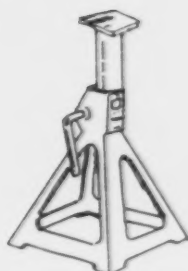
Satisfactory - Should move on ☐

Repeat this unit ☐

Student's Signature/Date _____

Instructor's Signature/Date _____

BODY FILLERS



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

BODY FILLERS

INTRODUCTION

Body fillers smooth a car's body by filling in dents that cannot be removed with bumping hammers and/or dollies. Use fillers only after you have repaired a surface as well as possible. Fillers are not a substitute for good metal work.

UNIT OBJECTIVE

After you complete this unit, you should be able to use plastic body fillers correctly and safely.

SPECIFIC OBJECTIVES

After you complete this unit, you should be able to:

1. Define seven terms that deal with plastic fillers.
2. Prepare a car's surface for plastic body filler.
3. Mix plastic body filler correctly.

4. Apply plastic body filler correctly.
5. Finish plastic body filler correctly.

Put a check beside the statement that is true for you.

☐

I can do these tasks and want to go through the
Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I
do the Performance Checklist.



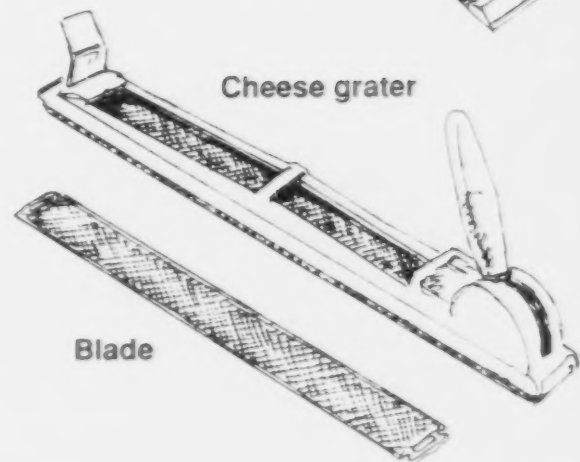
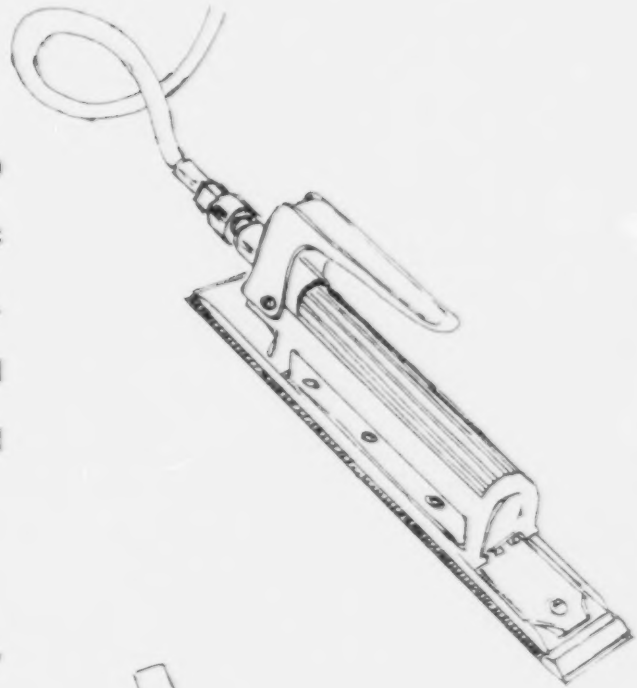
TURN PAGE AND BEGIN

A. TERMS

1. **Contour** - the outline of the surface of a panel.
2. **Cure** - to dry or harden. When a surface is curing, it is drying or hardening.
3. **Filler** - a material used to make a damaged area level or smooth.
4. **Hardener** - a curing agent that causes plastic resins to harden and dry.
5. **Knead** - to mix or blend. When you knead filler and hardener, you use a specific technique to blend filler with hardener.
6. **Pin holes** - tiny spaces in cured filler caused by improper mixing and too much hardener.
7. **Resin** - a substance used in plastic fillers to cause the filler to harden.

B. EQUIPMENT

1. **Air file** - a power tool used to sand large areas where plastic body fillers have been applied. An air file may also be called a "power file" or "speed sander."
2. **Cheese grater** - a coarse, open-toothed file used to shape plastic filler. A cheese grater may also be called a "grater file."
3. **Mixing paddle** - a stick used to mix filler and/or hardener. A mixing paddle may be a paint paddle or a putty knife. You can use a wooden paint paddle on either a plastic or metal mixing board. Use a

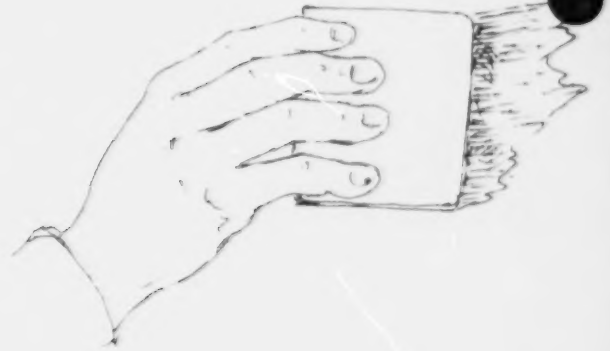


Blade



metal putty knife only on metal mixing boards.

4. **Plastic spreader** - a tool used to apply filler to a surface.



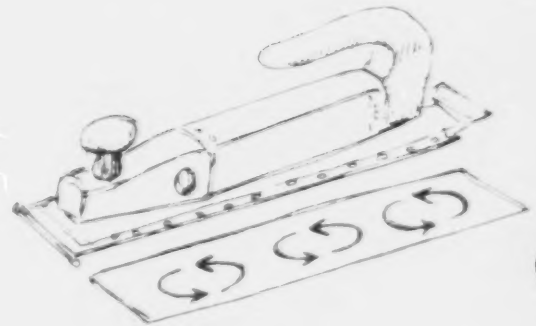
5. **Mixing board** - a surface, usually plastic, that holds filler and hardener while they are being mixed. **Never use cardboard for a mixing board.**



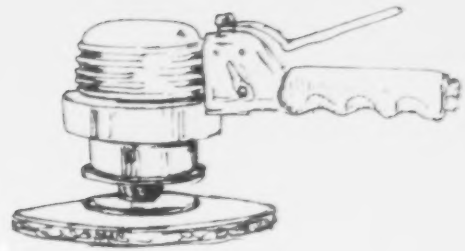
6. **Sanding block** - a tool used when hand sanding to prevent uneven finger pressure on sandpaper.



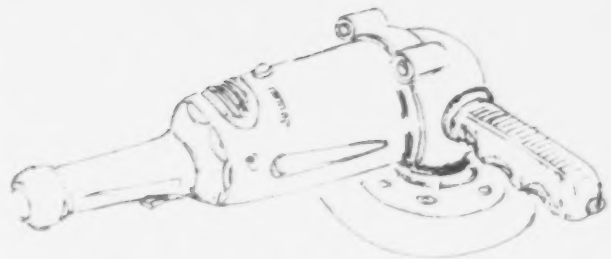
7. **Orbital Reciprocating Sander** - (also called a "jitterbug sander") a power tool used to level and smooth old paint or plastic filler.



8. **Random Orbital Sander** - (also called a "DA" sander) a power tool used for light sanding of small areas.



9. **Grinder** - a power tool used to remove paint to the bare metal.



C. SAFETY EQUIPMENT

10. **Particle Mask** - face cover worn when sanding plastic fillers. Breathing plastic filler dust is unsafe.



11. **Rubber gloves** - worn on the hands when working with hardeners. The hardener may absorb into the skin and cause liver damage.



12. **Safety goggles** - worn to protect your eyes. The sides form a seal around the eyes to insure that liquids or dust do not get in eyes from the side.



D. PLASTIC BODY FILLERS

Plastic (polyester) body filler is the finishing touch to most sheet metal repairs. After you have restored the basic shape and soundness of the damaged panel, you can cover the remaining blemishes with a coat of body filler. Body fillers only work well, however, if you are careful to prepare and apply them correctly.

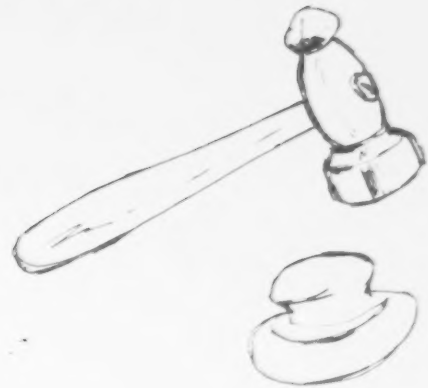
Plastic fillers come in cans or dispensers. Filler is sometimes called "mud" or "bondo." They must be mixed with a hardener before you apply them to a surface.



1. AREAS THAT CAN BE REPAIRED WITH BODY FILLER

Plastic fillers are used on large, shallow areas where putty and primers have not filled well. The following areas can usually be repaired with plastic fillers.

- a. Body sections that cannot be completely repaired with a hammer and dolly.



- b. Body sections that cannot be completely restored to their original shape by working from the inside of the panel.

- c. Panel holes or tears (after they have been properly repaired).



- d. Body sections that have been weakened or damaged by rust (after they have been properly repaired).

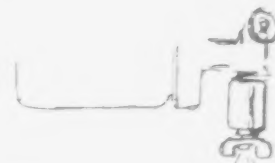
- e. Areas that have been patched by welding.



- f. Seams where complete panels have been replaced and fastened.

2. ADVANTAGES OF PLASTIC FILLERS

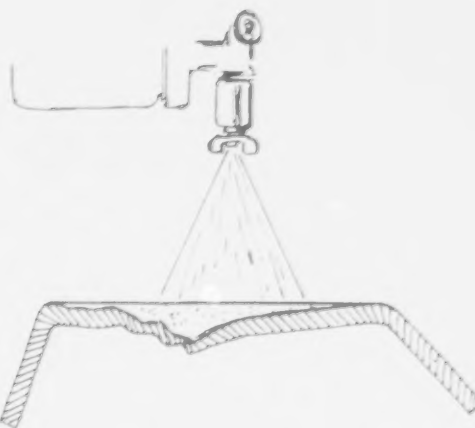
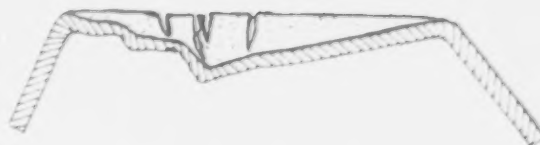
- a. Plastic fillers adhere (stick) well to a clean base metal.
- b. Plastic fillers cure (harden or set up) quickly.
- c. Plastic fillers form a hard surface that can be sanded and painted.
- d. Primers can be applied to plastic fillers **if** the surface has been prepared correctly.
- e. Plastic fillers last a long time.



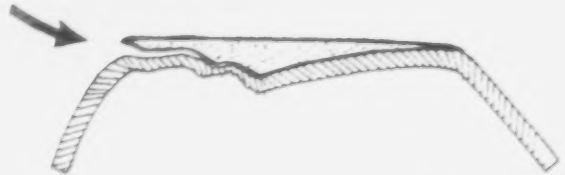
- f. Plastic fillers are not expensive.

3. DISADVANTAGES OF PLASTIC FILLERS

- a. Plastic fillers must be applied no thicker than 1/4 inch. If you use too much plastic filler, it may crack within a few months.
- b. If a plastic filler is to stick properly, you must apply it to a rough metal surface.
- c. Plastic fillers can be dangerous. When the plastic is sanded, a fine dust is created that may get into your lungs and cause breathing problems.



- d. Dust from sanded plastic can also drift into the paint booth and cause "dirty paint."
- e. Plastic filler cannot be used at the edge of a panel. Wetness can work under the edge and cause the filler to fall off.
- f. Plastic fillers will not bend. They cannot be used on flexible surfaces.

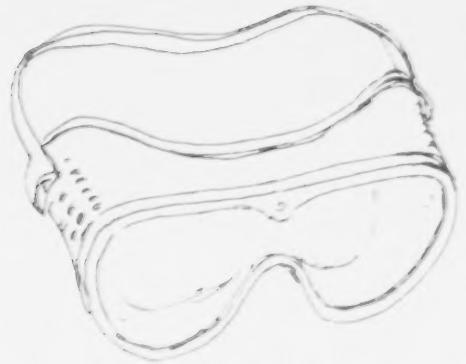


4. BODY FILLER SAFETY

- a. ALWAYS use body fillers in well ventilated areas.
- b. ALWAYS wear a particle mask when grinding or sanding plastic fillers.



- c. ALWAYS wear goggles.
- d. ALWAYS keep equipment free of oil and grease when working with plastic fillers.



DO SKILL SHEET 1

DO ACTIVITY SHEET 1

BODY FILLERS
SKILL SHEET 1

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. Plastic fillers are used on deep areas that have not been repaired yet.
- _____ 2. Another name for polyester plastic fillers is "mud."
- _____ 3. Plastic fillers last a long time.
- _____ 4. Plastic fillers do not cure quickly.
- _____ 5. Safety glasses are worn when using fillers.
- _____ 6. Sanding plastic can be dangerous.
- _____ 7. Particle masks are worn when sanding plastics.
- _____ 8. The metal surface should be "roughed up" before applying plastic.
- _____ 9. If too much plastic is applied, it may crack in a few months.
- _____ 10. Body filler should be used in a well ventilated area.

BODY FILLERS
ACTIVITY SHEET 1

Using panels provided by your instructor, decide whether plastic (1) should be used to fill a damaged area or (2) should not be used to fill a damaged area.

E. PREPARING THE SURFACE FOR PLASTIC FILLERS

1. Equipment:

Eye protection	Clean white cloth	Non-petroleum detergent
Grinder	Masking material	Wax and grease remover
Respirator	Drill and brush attachment	16- or 24-grit open-coat disc
Prefinishing cleaner or approved solvent		

2. Put on goggles.



3. Wash the panel with a soap that does not have an oil base.

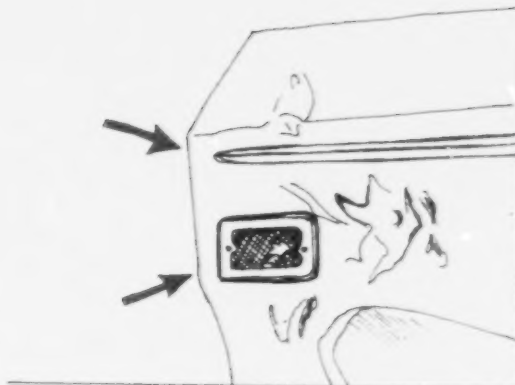
4. Rinse the panel well.



5. Dry the panel.

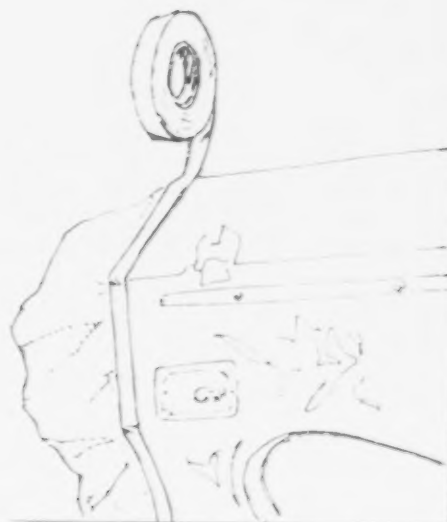
6. Clean the area with prefinishing cleaner or an approved solvent.

You do this to remove all wax and grease.



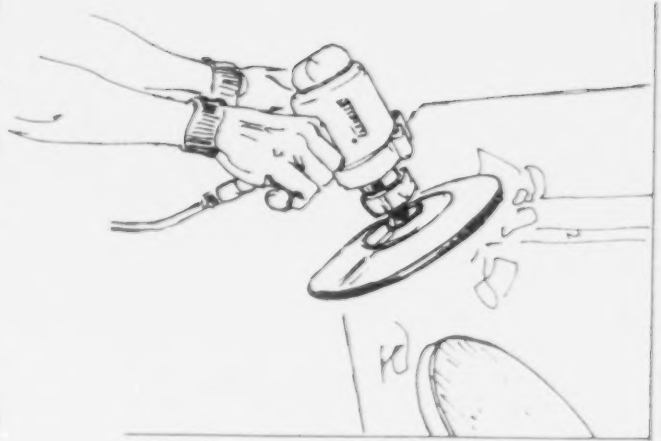
7. Mask or remove moldings.

8. Mask adjoining panels.



9. Grind the area to be filled.
Use either a 16- or 24-grit open-coat grinding disc. If the area is small, use a 7-inch disc. If the area is large, use a 9-inch disc.

Use just enough pressure to ensure proper surface contact. Move the grinder back and forth in long, sweeping, overlapping strokes.

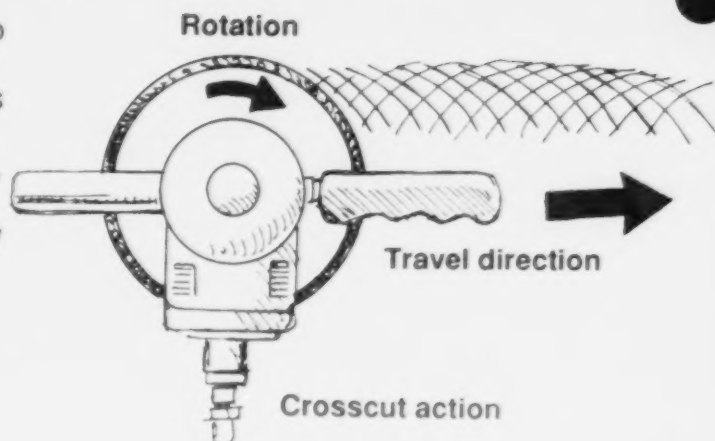


NOTE: Hold the grinder with both hands at about a five- (5) degree angle to the surface.

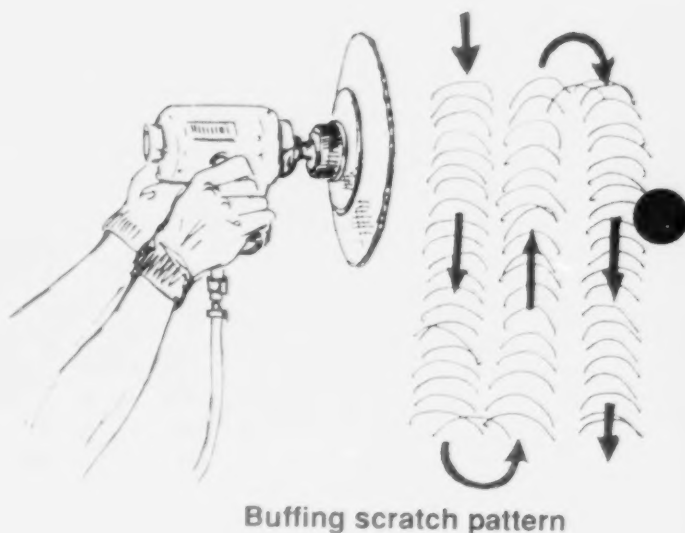
DO NOT: (1) move the grinder in circles, (2) hold the grinder in the same spot on the surface for too long or (3) hold the grinder flat against the surface.

CAUTION: Check the grinding disc manufacturer's recommendations to be sure the grinder you are using is of the correct RPM. RPM is the number of times an object rotates during one minute.

10. Move the grinder from side to side first. This movement is called the "cross-cut" method. It helps find the high and low spots on the surface.



11. Next, grind the area using an up-and-down motion. This movement is called "buffing." It helps reduce the ribs left by the cross-cut method.



12. If paint, rust, dust or scale is left in the low spots, attach a hexagon- or square-shaped disc and grind again.

13. If rust or other material is still on the surface, attach a rotary wire brush to a drill and brush the material off.
14. Blow away sanding dust with compressed air and/or wipe the surface with a tack rag to remove any dust particles.
15. Spray the area with epoxy primer.



DO SKILL SHEET 2

DO ACTIVITY SHEET 2

BODY FILLERS
SKILL SHEET 2

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. A prefinishing cleaner is applied after the grinding process is done.
- _____ 2. The grinder is moved in a circular motion if stubborn paint particles cannot be removed.
- _____ 3. The cross-cut method of grinding requires the grinder to be moved from side to side.
- _____ 4. Special square- or hexagon-shaped discs are used to remove large areas of rust.
- _____ 5. A rotary wire brush is used to remove paint, rust or scale from low spots.
- _____ 6. A buffing method of grinding is used to reduce the ribs left by the cross-cut method.
- _____ 7. One hand is used to hold the grinder.
- _____ 8. The grinder should be held at a five- (5) degree angle to the surface.
- _____ 9. The grinder should NOT be held in the same spot for too long.
- _____ 10. A 160-grit disc should be used.

BODY FILLERS ACTIVITY SHEET 2

Equipment:

Eye protection	Clean white cloth	Non-oil soap
Grinder	Masking material	Wax and grease remover
Respirator	Drill and brush attachment	16- or 24-grit open-coat disc
Prefinishing cleaner	Eye protection	Compressed air
Tack cloth		

PROCEDURE

Evaluation

3 2 1 N

1. Put on eye protection and remove any trim that will not be masked.

— — — —

2. Wash, rinse and dry panel.

— — — —

3. Clean with prefinishing cleaner.

— — — —

4. Mask or remove moldings.

— — — —

5. Mask adjoining panels. _____
6. Grind area using cross-cut method. _____
7. Grind are using buffing method. _____
8. Grind area with square- or hexagon-
shaped disc. _____
9. Use wire brush and drill appropriately. _____
10. Clean with compressed air and/or tack
cloth. _____
11. Spray with epoxy primer. _____

F. MIXING AND APPLYING PLASTIC FILLERS AND HARDENERS

1. Equipment:

Rubber gloves	Mixing board	Putty knife
Plastic spreader	Hardener	Plastic filler
Eye protection	Air file	

2. Check the surface. It should not be dusty or moist. If the surface has dust or moisture on it, wipe it with a clean, dry, lint-free cloth.

3. Read the directions on the filler container. Directions for one filler may be different from directions for another. Follow directions closely.



4. Using a plastic spreader, scoop the plastic filler onto a clean, smooth mixing board. It's best to begin with a golf-ball-sized lump of plastic, at least until you've had lots of practice.



NOTE: Never mix more of the plastic than you can use before it sets up. (Working time is about 10 minutes. The mixture will set in 30 minutes.)

5. Read and follow the directions on the container of hardener. Some tubes of hardener should be kneaded before squeezing them. This helps make it just right--the consistency of toothpaste.



6. Put on rubber gloves.



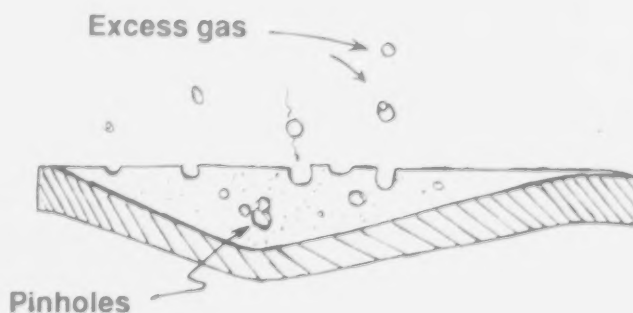
CAUTION: Hardener can be absorbed through the skin, which can cause liver damage.

7. Apply the recommended amount of hardener to the top of the plastic.



NOTE: Generally, a golf-ball-sized lump needs a one- to two-inch ribbon of hardener. On hot days the filler cures quickly, so use less hardener. On cold days the filler cures slowly, so use more.

CAUTION: If you add too much hardener, the mixture will cure before you can apply and smooth it. It may also form pinholes as it cures.

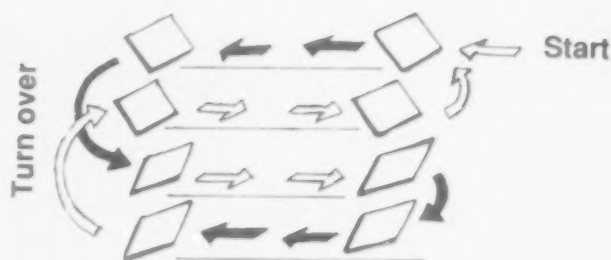


CAUTION: Do not let hardener
get in the container of plastic.
Lumps will form in the plastic.

8. Mix hardener and plastic with
a plastic spreader or putty
knife.



9. Scoop the mixture up from
the bottom, turn the spreader
(or putty knife) over and
press down on the mixture.
Knead the hardener and filler
until the mixture is smooth
and creamy.



NOTE: The hardener has color.
The filler is gray or white. The
mixture should be all one color.
There should be no streaks.

CAUTION: Do not "whip" or mix too fast. Air bubbles can cause pinholes.

10. Using a clean plastic spreader (not the one you mixed with), quickly apply one thin coat of the mixture to the area to be filled.



11. If the surface is close to being the proper shape, you may only need one coat.

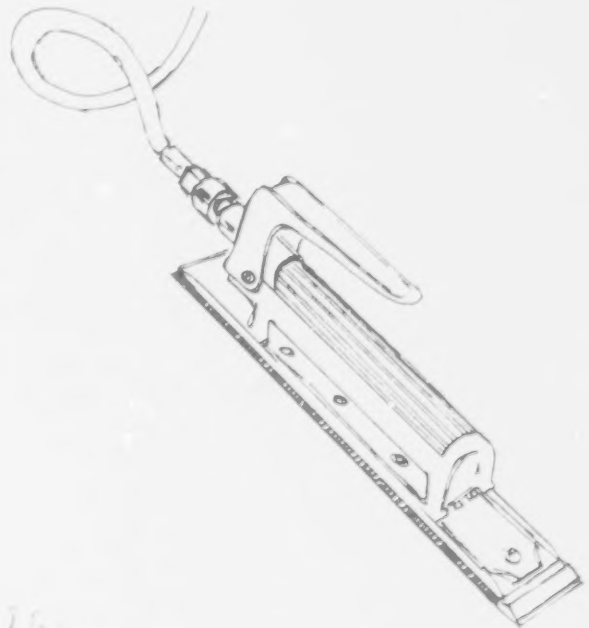
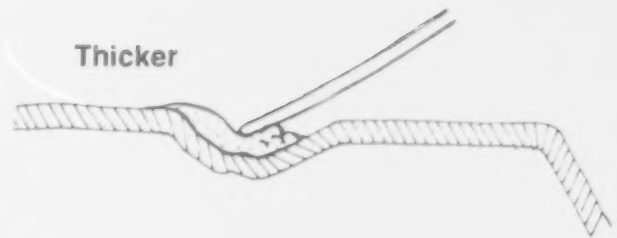
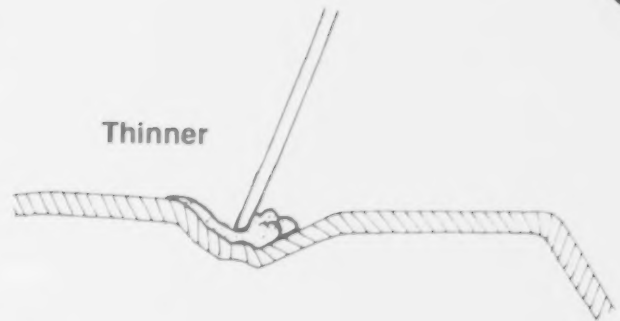
NOTE: Apply the mixture evenly and in one direction. Use some pressure on the spreader as you apply the first coat. Let up on the pressure when you apply the second coat.

NOTE: The more horizontally (side-to-side) you hold the spreader, the thicker the layer of plastic that builds up on the surface. If the surface needs a thinner coat, hold the spreader more vertically (up-and-down).

12. Allow the first coat to cure (set up).

NOTE: When your fingernail is not able to scratch the filler, the filler is ready to be sanded or filed.

13. File the surface with an air file. Filing the surface will make the surface rough enough to apply a second coat.

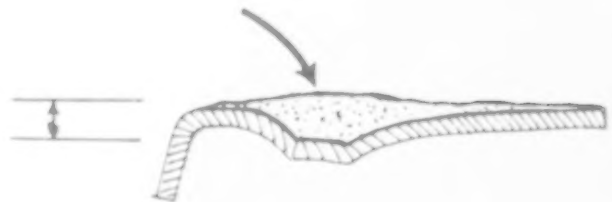


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14. Apply the second coat. This coat should be a little thicker than the first, but still thin.

NOTE: Use less force when you apply the second coat.

15. Allow the second coat to cure.
16. If a third coat is needed, rough up the second coat with an air file.
17. Apply as many thin coats as needed to get the proper buildup. The buildup must be higher than the proper shape of the panel but should **NEVER** be more than 1/4 inch thick.



NOTE: If you find a crease or low spot, let the first built-up layer set up, then rough the surface. Apply more layers of filler directly to the low spot. However, all layers added together **must not be more than 1/4 inch thick.**

18. Apply thin coats to pinholes and other imperfect spots.
19. Clean the plastic spreader and mixing board with lacquer thinner or an approved solvent after each use.



DO SKILL SHEET 3

DO ACTIVITY SHEET 3

BODY FILLERS
SKILL SHEET 3

Directions: Choose and circle the best answer.

1. If the surface has dust on it, you should wipe it with
 - a. a paper towel.
 - b. an oil treated cloth.
 - c. a clean, dry, lint-free cloth.
 - d. a wet cloth.
2. A mixture of plastic and hardener will set up in about
 - a. 10 minutes.
 - b. 20 minutes.
 - c. 30 minutes.
 - d. one hour.
3. A golf-ball-sized lump of filler needs how much hardener ribbon?
 - a. 1 to 2 inches
 - b. 1 to 2 feet
 - c. 3 to 4 inches
 - d. 3 to 4 feet
4. If you use too much hardener, you may end up with
 - a. "orange peel" effect.
 - b. "pinholes."
 - c. "peeling."
 - d. "cracking."

5. When you mix hardener and plastic, the motion you use is called
- a. whipping.
 - b. beating.
 - c. kneading.
 - d. stirring.
6. The mixture is applied to the surface with a
- a. squeegee.
 - b. putty knife.
 - c. plastic applicator.
 - d. all of the above
7. You should never apply the mixture of hardener and filler thicker than
- a. 1/8 inch.
 - b. 1/4 inch.
 - c. 1/2 inch.
 - d. 3/4 inch.
8. After you apply the filler, you rough up the surface with a(n)
- a. air file.
 - b. orbital sander.
 - c. grinder.
 - d. sanding block.
9. The buildup of filler should be _____ the original contour of the surface.
- a. even with
 - b. higher than
 - c. lower than
 - d. one inch higher than

10. Once you have mixed the filler and hardener, you should apply it
- a. immediately.
 - b. after it sets for 10 minutes.
 - c. after it has cured.
 - d. in direct sunlight.

BODY FILLERS
ACTIVITY SHEET 3

Equipment:

Rubber gloves

Mixing board

Plastic spreader

Hardener

Plastic filler

Eye protection

Air file

PROCEDURE

Evaluation

3 2 1 N

1. Check the surface for dust.

— — — —

2. Read instructions on filler and hardener
containers.

— — — —

3. Put on rubber gloves.

— — — —

4. Estimate the amount of filler you need
(the size of a golf ball). _____
5. Put filler on the mixing surface. _____
6. Apply the hardener to the filler according
to the directions on the labels. _____
7. Mix the ingredients thoroughly and
properly. _____
8. Scoop a small amount of filler onto the
applicator. _____
9. Apply a thin coat over the area to be
filled. (Push inward.) _____
10. Apply a proper amount of filler, one layer
at a time, in order to build the filler a little
higher than the original contour. _____
11. Clean the applicator and mixing board. _____

G. PROCEDURE FOR FINISHING BODY FILLER

1. Equipment:

Cheese grater	24-, 36- and 40-grit discs	Particle mask
Finishing sander	80-grit paper	Clean cloth
Eye protection	Metal conditioner	

2. Check the filler to make sure it has cured properly.

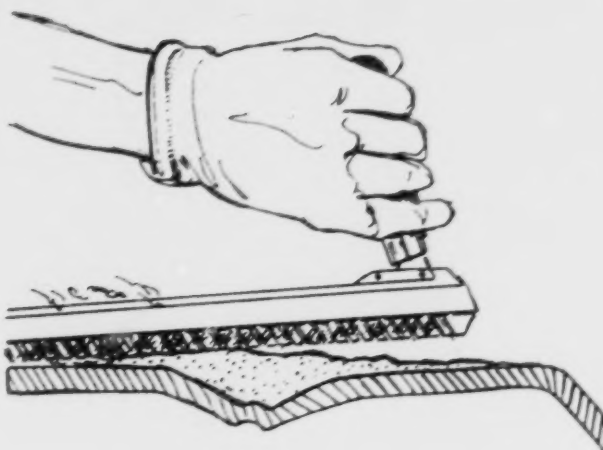
NOTE: Curing will usually take five to 15 minutes at 70 degrees Fahrenheit.

3. Put on goggles and particle mask.

CAUTION: Always wear a particle mask when sanding or grinding plastic body filler. The dust from the sanding and grinding operations is harmful to breathe.



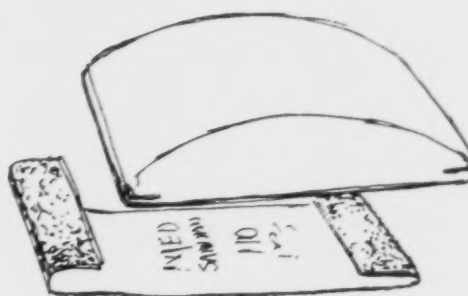
4. Begin to shape the filler.
You may do this with a cheese grater before the filler has fully cured.



5. Remove the top surface of the filler.

NOTE: The top surface of the filler may be soft, depending on the kind of plastic used.

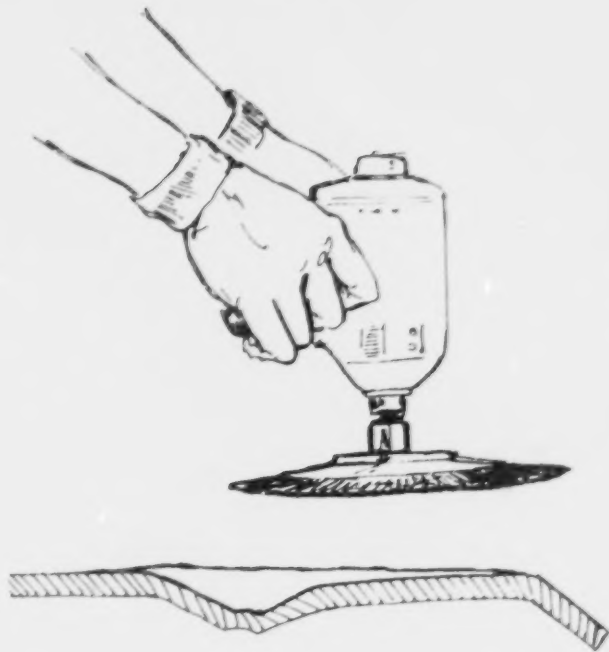
NOTE: Do not use sandpaper files during the first shaping process if the top surface is still soft. The paper will become clogged almost immediately.



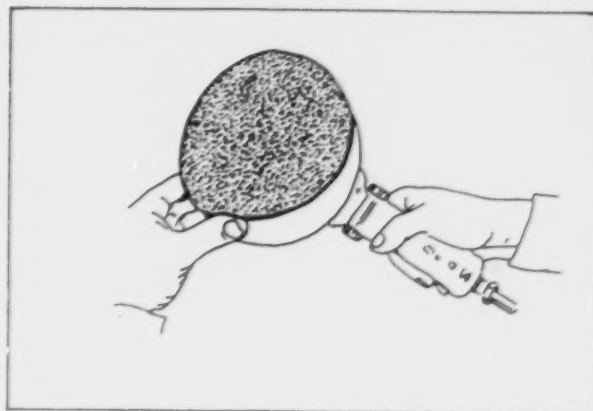
6. Check for low spots. If you find low spots, mix and apply more filler. Repeat steps one through five.



7. Use a finishing sander (a jitterbug or orbital disc sander). Attach a 36- or 40-grit piece of sandpaper to the sander.
8. Place the sander flat on the surface and sand in straight lines **with the contour**. Change directions 30 to 45 degrees in both directions occasionally to prevent waves in the filler. (This is like the "crosscut" and "buffing" strokes you learned with the grinder earlier.)
9. Sand the surface until you reach the proper contour.



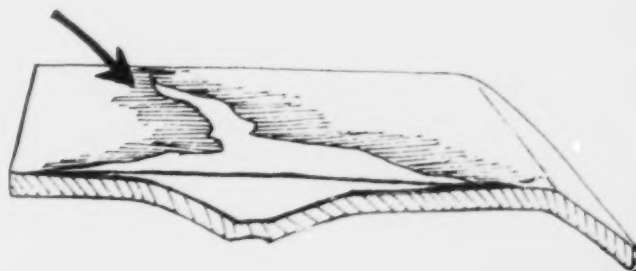
10. Put 80-grit sandpaper on the sander. Sand until the scratches left by the 36- or 40-grit paper become smooth.



CAUTION: During these final sanding steps, be sure to allow for more of the filler to be sanded off the top. If you sand too much, you make a low spot.

NOTE: Never sand with a grit finer than 80. It will cause the surface to be too smooth for a good adhesion.

11. Featheredge broken edges surrounding the repaired surface. Use the proper sander and disc.
12. Finish with a 180-grit.



13. Apply metal conditioner to any bare metal to prevent rust.
14. Wipe conditioner off immediately with a clean wet cloth.



DO SKILL SHEET 4

DO ACTIVITY SHEET 4

BODY FILLERS
SKILL SHEET 4

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- ___ 1. The shaping process may be done with a grinder.
- ___ 2. Don't use sandpaper in the early stages of shaping because the filler is probably still a little soft.
- ___ 3. The cross-cut and buffing method of sanding is used when a power sander is used.
- ___ 4. Metal conditioner is used and allowed to dry on bare metal areas of the surface.
- ___ 5. The only safety equipment you need is safety glasses.
- ___ 6. If there are low spots in the surface, another inch of filler should be applied.
- ___ 7. During the final sanding operation, 1500 grit paper should be used to make sure all the scratches have been removed.
- ___ 8. A cheese grater is a power tool.
- ___ 9. Always sand in one direction during the shaping process.
- ___ 10. The sander is held at an angle of 5 degrees to the surface.

BODY FILLERS
ACTIVITY SHEET 4

Equipment:

Cheese grater

Finishing sander

24-grit, 36-grit, 40-grit disc

80-grit sander

Metal conditioner

Clean cloth

Particle mask

Eye protection

PROCEDURE

Evaluation

3 2 1 N

1. Check surface for proper curing.

— — — —

2. Put on safety equipment.

— — — —

3. Remove surplus material using correct procedure:

Cheese grater

Power sander

4. Re-apply filler if low spots remain.

5. Sand with 36 or 40-grit paper.

6. Sand using proper technique.

7. Sand until proper contour is reached.

8. Resand with 80-grit paper.

9. Featheredge broken edges.

10. Apply metal conditioner to bare metal.

BODY FILLERS
UNIT TEST

Directions: Match the following definitions in the right column with their terms in the left column.

- | | |
|---|------------------|
| _____ 1. Tiny spaces in cured filler caused by improper mixing and too much hardener. | A. Cure |
| _____ 2. A curing agent that causes plastic resins to harden. | B. Filler |
| _____ 3. Any material used to level a damaged area. | C. Cheese grater |
| _____ 4. Coarse open-toothed file used to shape plastic filler. | D. Pin holes |
| _____ 5. To dry and harden. | E. Hardener |
| _____ 6. A substance used in plastic filler to cause them to harden. | F. Knead |
| _____ 7. Mixing technique used to properly blend filler and hardener. | G. Resin |

Directions: Circle the best answer from the choices listed.

____ 8. Plastic body filler should never be applied thicker than

- | | |
|---------------|--------------|
| a. 1/16 inch. | b. 1/8 inch. |
| c. 1/4 inch. | d. 1/2 inch. |

____ 9. Working time for plastic filler is about

- | | |
|----------------|----------------|
| a. 5 minutes. | b. 10 minutes. |
| c. 20 minutes. | d. 30 minutes. |

____ 10. Plastic filler should not be used to fill out a panel edge because

- | | |
|--|-------------------------------|
| a. it might chip. | b. the filler might fall out. |
| c. moisture might work under the edge. | d. all of the above |

Directions: Place a "T" in front of statements below that are true. Place an "F" in front of statements that are false.

- ___ 11. Read and follow all instruction labels on filler and hardener containers.
- ___ 12. Never mix more plastic filler than you can apply in one hour.
- ___ 13. Never return mixed plastic to the container because it will contaminate the filler.
- ___ 14. Mix ingredients on a clean sheet of cardboard.
- ___ 15. Mix until base material is uniformly streaked throughout.
- ___ 16. Use a wide-bladed putty knife to knead the two ingredients by scooping from the bottom and turning the putty knife over to press down on the mixture.
- ___ 17. Always thoroughly clean plastic applicator and mixing board in solvent after each use.
- ___ 18. On a hot day, plastic filler will cure faster, so more hardener should be used.
- ___ 19. If the plastic filler gets hard enough to resist scratching with your fingernail, it means too much hardener was used.
- ___ 20. "Mud" is another name for polyester plastic.

BODY FILLERS
PERFORMANCE CHECKLIST

Student _____ has successfully performed the following tasks:

	YES	NO	COMMENTS
1. Defined seven terms that deal with plastic fillers.			
2. Prepared a car's surface for plastic body filler.			
3. Mixed plastic body filler correctly.			
4. Applied plastic body filler correctly.			
5. Finished plastic body filler correctly.			

Satisfactory - Should move on

☐

Repeat this unit

☐

Student's Signature/Date

Instructor's Signature/Date

SURFACE PREPARATION



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

SURFACE PREPARATION

INTRODUCTION

A car's finish is very important. The finish protects the car from weather and chemicals. It is also the first thing a customer notices.

As an auto body repair technician, you must know which refinishing technique to use for each job.

UNIT OBJECTIVE

After completing this unit, you should be able to choose the proper refinishing technique and the proper tools to do the job.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Study a car's surface to determine which surface preparation technique to use.
2. Define eight auto body terms.
3. Identify four auto body tools used when refinishing.
4. Follow safety rules when in the auto body lab.
5. Wash a car to prepare it for refinishing.

Check the Statement that Fits You Best.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



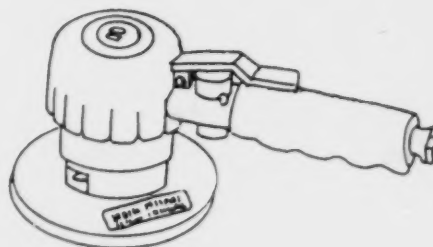
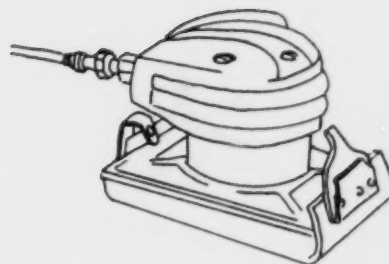
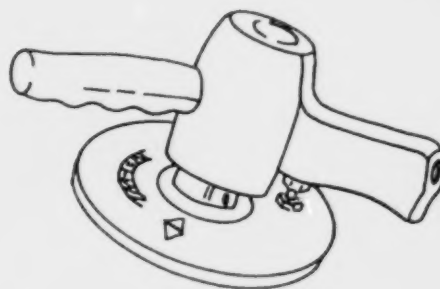
TURN PAGE AND BEGIN

A. TERMS

1. **Bare metal** - metal that has no primer, paint or factory finish on it.
2. **Burrs** - rough, jagged edges or places on the metal.
3. **Cleaning operation** - the process of washing and smoothing the surface.
4. **Featheredging** - tapering the edges of ground-off, chipped paint or plastic.
5. **Pneumatic** - powered by air.
6. **Serrate** - to cut.
7. **Thorough sanding** - sanding that is done to level or smooth the primer.
8. **Undercoat** - a layer of paint material, such as a primer, that lies beneath the topcoat.

B. EQUIPMENT

1. **Grinder** - a tool used to (1) level a repaired area, (2) smooth scars left from body repair and (3) rough up surfaces before filler is applied.
2. **Orbital-Reciprocating Sander** (also called the "jitterbug sander") - a tool used to level and smooth old paint or plastic filler.
3. **Random Orbital Sander** - a tool used for light sanding of small areas.
4. **Sanding Block** - a tool used when hand sanding to prevent uneven pressure from the fingers.



C. IDENTIFYING DIFFERENT SURFACE-PREPARATION TECHNIQUES

After damage on the surface has been repaired, you must decide how much of the vehicle will be repainted. This decision is based on:

1. the type of repair that was done,
2. the type of paint on the car,
3. the condition of the paint on the car, and/or
4. the cost of the total job.

Repainting may be needed for (1) an entire surface or (2) only a small area of a surface ("spot repair"). If only part of a surface is to be repainted, you must decide how much of it must be masked. When doing spot repair, you must also make sure the new paint gradually blends into the old paint around the spot.

Refinishing may restore or change the color of a vehicle. Either way, the surface will probably need to be sanded. There are two basic surface preparation (sanding) techniques: (1) "power" sanding and (2) "hand" sanding. (Either you sand by hand or you use a power sander.) It is important for you to know which sanding technique to use for the job.

D. POWER SANDING

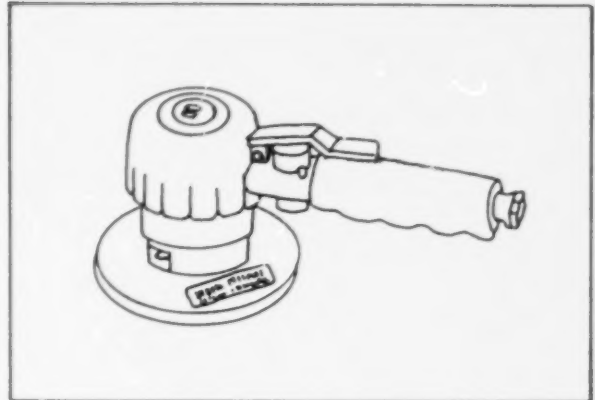
You will use pneumatic (powered by air) or electric (powered by electricity) sanding tools if a great deal of sanding is needed. If the surface is in fair to poor condition, use power sanding.

The most commonly used tools are:

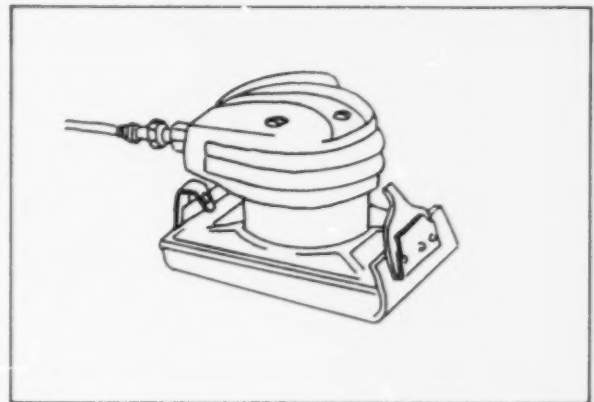
1. the orbital reciprocating sander,
2. the random orbital sander and
3. the grinder.

AUTO BODY SURFACE PREPARATION

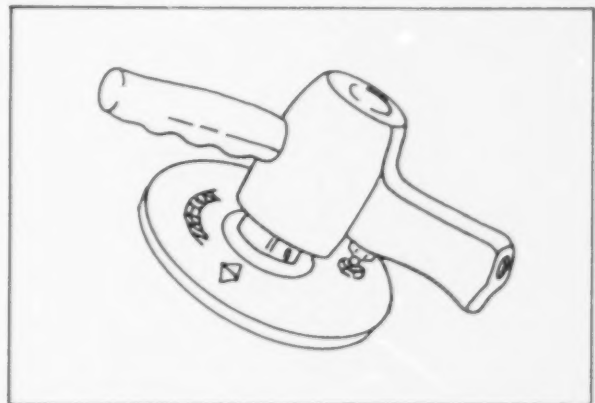
1. The random orbital sander, or D.A. sander, is used (1) to smooth metal, (2) to sand small areas of a damaged surface and (3) to prepare the surface after damage has been repaired.



2. The orbital-reciprocating sander, or jitterbug sander, is mainly used to level and smooth old paint and plastic filler. It is used in the cleaning operation.



3. The grinder is used to remove paint and rough up an old finish before you apply body filler and do the metal finishing. Grinders are also used to remove scars left on the metal or paint from body repair.



E. HAND SANDING

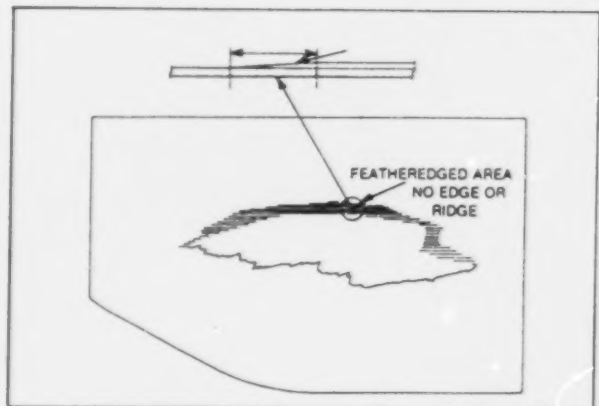
You use hand sanding (1) when only a small area needs to be refinished, (2) when you've already used a power sander or (3) when you sand bare metal.

You use coarse sandpaper to remove burrs in the metal. If the metal needs only to be smoothed, use fine sandpaper.

1. Thorough sanding is a technique used (1) when the old finish is rough or in poor condition or (2) when a primer needs to be smoothed or leveled. In thorough sanding, you first use a coarse grit paper and then a fine grit. When smoothing a primer, use fine grit paper.

2. Light sanding, or scuff sanding, is a technique used when the old finish is in good condition. Scuff sanding helps the new paint adhere (stick) to the surface.

3. Featheredging is a technique you use to prepare a surface. It is done to keep the broken edge of the painted or filled area from showing through the new paint.



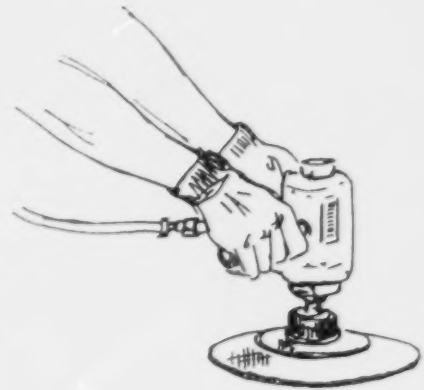
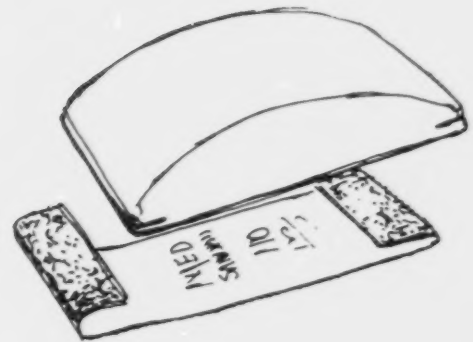
AUTO BODY SURFACE PREPARATION

You must use a sanding block if you are featheredging by hand. Featheredging may be done (1) with a chemical, (2) by hand or (3) with an orbital sander.

In chemical featheredging, you use a special chemical to create a featheredge. The technique is used only when the old finish is lacquer. Follow the chemical manufacturer's instructions carefully.

4. Dry sanding, by hand or with a power sander, is used (1) to smooth metal, (2) to repair plastic or (3) to sand old paint. Dry sanding will not get masking material wet. A serrate abrasive is used to prevent clogging of the sandpaper.

5. Wet sanding is usually used just before the car is painted. Wet sanding keeps sandpaper from clogging. The water washes away buildup and residue from the sanding process that could cause scratches on the surface.



CAUTION: Be careful not slip on a wet floor when you are doing wet sanding.

CAUTION: Do not do wet sanding near electrical tools!

When wet sanding, you must be careful not to get your masking paper or tape wet. Wet masking paper or tape falls off and allows paint to leak through.

DO SKILL SHEET 1
DO ACTIVITY SHEET 1

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SURFACE PREPARATION

SKILL SHEET 1

Directions: Place the letter of the best word that goes with each numbered statement.

- | | | |
|---------|---|-----------------------|
| ___ 1. | Another name for a "random orbital sander" | A. Grinder |
| ___ 2. | A tool used in cleaning operations | B. Thorough sanding |
| ___ 3. | The most common tool used to remove old paint | C. Wet sanding |
| ___ 4. | The process used when refinishing small areas | D. D.A. |
| ___ 5. | The technique used to level and smooth primer | E. Power sanding |
| ___ 6. | The technique used when the old finish is in good shape | F. Scuff sanding |
| ___ 7. | The technique used to keep edges of a painted surface or filled area from showing through new paint | G. Chemical stripping |
| ___ 8. | The sanding operation that is done just before painting | H. Jitterbug |
| ___ 9. | The technique used when the old finish is badly weathered | I. Feather-edging |
| ___ 10. | Sanding with an electrically- or air-powered tool | J. Hand sanding |

SURFACE PREPARATION

ACTIVITY SHEET 1

Directions: Using the tools your instructor will provide, identify the following:

1. Grinder
2. Sanding block
3. Orbital-reciprocating sander
4. Random orbital sander.

Directions: Using a panel or vehicle provided by your instructor, tell which technique you would use to prepare the surface and why you would use it. Explain why you would not want to use the other techniques.

5. Scuff sanding
6. Thorough sanding
7. Chemical stripping
8. Featheredging

F. PROCEDURES FOR WASHING AND CLEANING SURFACES

Washing and cleaning removes dirt and grime so they will not be driven into the old finish by the sanding process. If you are to refinish the entire vehicle, it needs to be washed and cleaned. When you are only refinishing part of the car, wash that section first. Before the customer gets the vehicle, the entire vehicle should be thoroughly washed again.

PREPARING THE ENTIRE VEHICLE

1. Equipment:

Sponge or washing mitt
Wax and grease remover
Non-oil detergent

Hose
Clean cloths
Bucket

2. Mix detergent and water in a bucket.

3. Hose down the entire vehicle.

NOTE: If you are using a pressure washer, steps two and three are not necessary.

4. Begin with the highest flat areas, such as the hood or decks.

NOTE: Wash one area at a time.

5. Rinse each area with clean water after you have washed it. Make sure no signs of detergent are left on the vehicle.



6. After you have washed flat areas, wash the sloped areas.

7. Rinse the sloped areas. Rinse other areas again.



8. After each area has been washed and rinsed, dry the vehicle.

NOTE: If time allows, air dry. Drying may be done with a blow gun or a clean cloth.

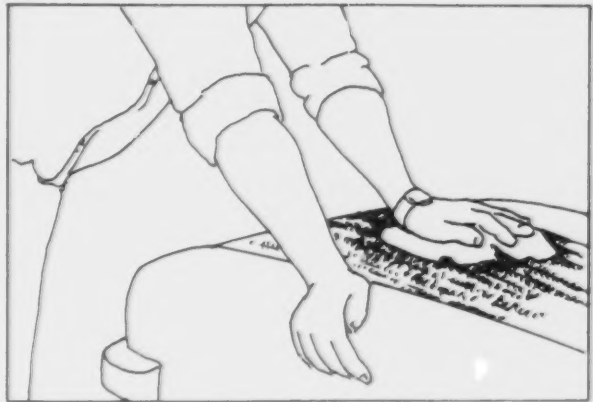
9. Apply wax and grease remover.



10. Saturate the cloth with cleaner.

NOTE: Cloth should not be dripping with cleaner.

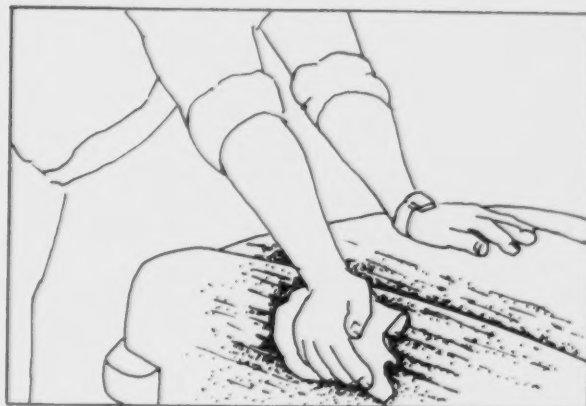
11. Rub the cloth on the area in a back-and-forth motion. Apply to one panel at a time.



NOTE: If a great deal of oil is on the vehicle, allow the remover to soak in. After the remover has soaked in for a few minutes, wipe it off and check your progress. **ALL OIL AND GREASE MUST BE REMOVED.**

12. Use another clean, dry cloth to wipe the area dry **IMMEDIATELY.**
13. Put cleaner on cloth again and apply it to another panel. This panel should be next to the one you just cleaned.

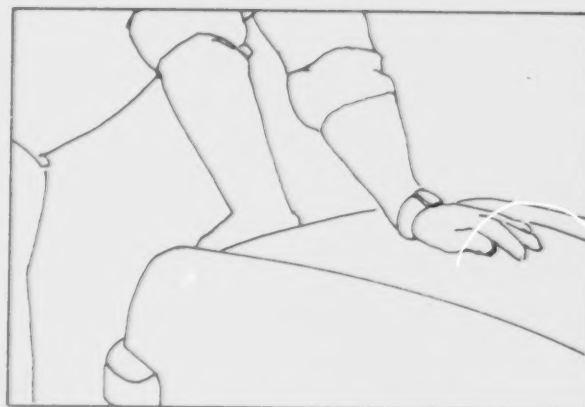
14. As you apply the remover, overlap it a few inches on the panel you just cleaned. This will ensure that all of the vehicle will be cleaned.



15. Again wipe this area dry with a clean, dry cloth.

NOTE: Change cloths often. This will ensure that all grease and oil will be removed.

16. Repeat this process until the entire vehicle has been cleaned.
17. Make sure no dirt, oil or grease is left on the vehicle.



DO SKILL SHEET 2
DO ACTIVITY SHEET 2

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SURFACE PREPARATION

SKILL SHEET 2

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. When you do spot repair, the entire vehicle should be washed before the refinishing process begins.
- _____ 2. The highest flat areas should be washed first.
- _____ 3. After washing a vehicle, apply a chemical stripper to remove grease and oil.
- _____ 4. Detergent does not need to be mixed with water before it is applied to a surface.
- _____ 5. The entire vehicle should be washed thoroughly before it is rinsed.
- _____ 6. Wax and grease remover should never be allowed to stay on the surface for more than 30 seconds.
- _____ 7. The wax and grease remover should be applied to one panel at a time.

- ___ 8. A wet cloth is used to wipe off the wax and grease remover.
- ___ 9. The same cloth should be used throughout the entire cleaning operation.
- ___ 10. Wax and grease remover should not overlap areas previously cleaned.
- ___ 11. Wax and grease remover should be applied to the surface with a circular motion.
- ___ 12. Always use a petroleum detergent.
- ___ 13. The vehicle should be washed and cleaned again before the customer gets it.
- ___ 14. Pressure washers should not be used.
- ___ 15. When wax and grease remover is put on the cloth, the cloth should be dripping with remover.

**SURFACE PREPARATION
ACTIVITY SHEET 2**

Equipment:

Sponge or washing mitt	Hose	Non-petroleum detergent
Wax and grease remover	Bucket	Clean cloths
Blow gun (optional)		

Procedure:

Evaluation

3 2 1 N

- | | |
|--|-----|
| 1. Mix detergent and water | --- |
| 2. Hose down entire vehicle | --- |
| 3. Start washing highest flat areas | --- |
| 4. Rinse each area thoroughly | --- |
| 5. Move to appropriate area after high flat area | --- |
| 6. Re-rinse areas as washing progresses | --- |
| 7. Dry vehicle properly | --- |
| 8. Apply wax and grease remover properly | --- |
| 9. Examine vehicle for grease, oil and dirt | --- |

SURFACE PREPARATION

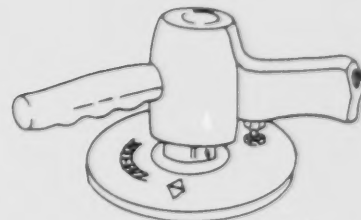
UNIT TEST

Directions: Match the term in the right column with the corresponding definition in the left column.

- | | |
|---------------------------|---|
| ___ 1. Serrate | A. The technique of cleaning and smoothing the old surface |
| ___ 2. Undercoat | |
| ___ 3. Featheredging | B. Metal that has no paint or factory finish on it |
| ___ 4. Burrs | |
| ___ 5. Pneumatic | C. Rough places in the metal |
| ___ 6. Thorough sanding | D. Tapering the edges of ground off or chipped paint or plastic |
| ___ 7. Cleaning operation | E. Cutting |
| ___ 8. Bare metal | F. Powered by air |
| | G. Layers of paint material such as primer or sealer |
| | H. The technique used to level or smooth primer |

Directions: Identify the tools below.

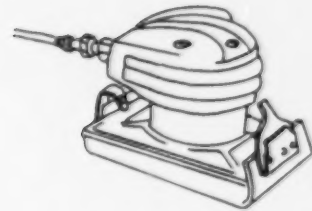
9. _____



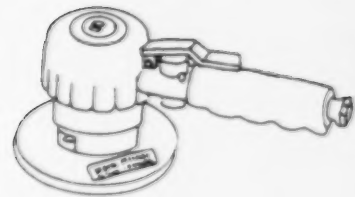
10. _____



11. _____



12. _____



Directions: Circle the best answer from the choices listed.

13. Refinishing may be needed to

- | | |
|------------------------------------|---|
| a. repair the surface | b. change the color of an entire vehicle. |
| c. restore the color of a vehicle. | d. a, b and c |

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**AUTO BODY
SURFACE PREPARATION**

14. The tool most commonly used to remove large areas of old finish is called a
- a. jitterbug sander.
 - b. DA sander.
 - c. grinder
 - d. belt sander.
15. A reason for sanding would be
- a. to remove paint
 - b. to provide a smooth surface
 - c. to provide adhesion
 - d. a, b and c
16. In areas to be repainted, where the old finish is in good condition, which type of sanding would you use?
- a. Thorough sanding
 - b. Scuff sanding
 - c. Featheredging
 - d. Grind sanding
17. In areas to be repainted, where parts of the old finish have been removed to the bare metal, which type of sanding would you use?
- a. Thorough sanding
 - b. Scuff sanding
 - c. Featheredging
 - d. Grind sanding
18. The amount of the vehicle's surface to be repainted depends on
- a. the type of metal
 - b. the type of paint
 - c. the condition of the vehicle.
 - d. a, b and c

Directions: Mark a "T" if the statement is true and an "F" if the statement is false.

- _____ 19. Wet sanding is faster than dry sanding.
- _____ 20. Wet sanding prevents the sandpaper from clogging.
- _____ 21. Wet sanding leaves behind residue that could cause scratches.
- _____ 22. Chemical strippers are used to remove grease.
- _____ 23. Hand sanding is used after power sanding is done.

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AUTO BODY
SURFACE PREPARATION

Directions: Put the steps for washing a vehicle in order. The first step will be number "24," the second step will be number "25," etc.

- _____ 24. A. Rinse each area and others already rinsed
- _____ 25. B. Dry the vehicle
- _____ 26. C. Examine the vehicle for dirt and grime
- _____ 27. D. Mix detergent and water
- _____ 28. E. Apply wax and grease remover
- _____ 29. F. Begin with highest flat areas
- _____ 30. G. Wipe wax and grease remover dry
- _____ 31. H. Hose down the vehicle

SURFACE PREPARATION

PERFORMANCE CHECKLIST

Student _____ successfully performed
the following tasks:

	Yes	No	Comments
1. Studied a car's surface to determine which surface preparation technique to use.			
2. Identified eight auto body terms used when refinishing.			
3. Followed auto body shop safety rules.			
4. Washed a car to prepare it for refinishing.			

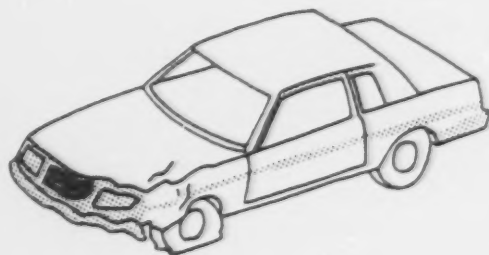
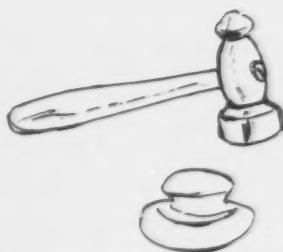
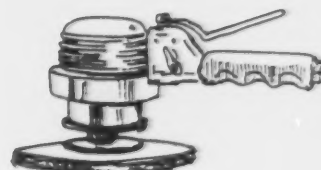
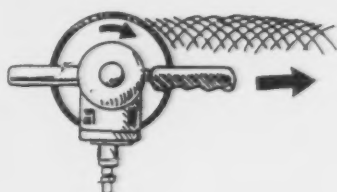
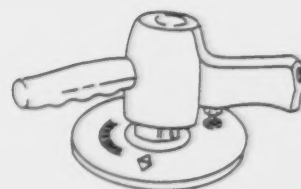
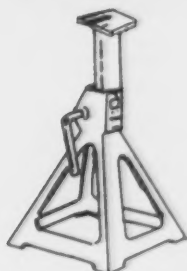
Satisfactory -- should move on _____

Should repeat this unit _____

Student's signature/Date

Instructor's signature/Date

SANDING TECHNIQUES



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

SANDING TECHNIQUES

INTRODUCTION

After analyzing the surface and deciding which sanding technique to use, the auto body repair person must perform each procedure correctly, skillfully and carefully.

UNIT OBJECTIVE

After completing unit, you should be able to perform various auto body sanding techniques.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Define 16 auto body terms associated with sanding.
2. Identify various abrasives and grit sizes.
3. Select the proper tools and equipment for dry sanding, wet sanding and featheredging.

4. Demonstrate the techniques of dry sanding, wet sanding and featheredging.
5. Follow safety rules when in the auto body lab.

Check the Statement that Fits You Best.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



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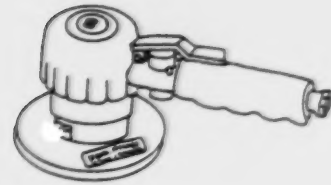
A. TERMS

1. **Abrasive** - a substance used to wear away a surface by friction.
2. **Back-sanding** - a technique that prepares the surface beyond the featheredged area so that a primer may be applied.
3. **Cleaning operation** - a process that prepares the surface for painting.
4. **Closed coat abrasive paper** - a sandpaper on which the surface grains completely cover the sanding side of the paper backing.
5. **Conversion coating** - a material that puts a zinc coating on the surface to prevent rust.
6. **Emblems** - name plates, hood ornaments, etc.
7. **Featheredging** - a technique that uses sandpaper to taper paint layers from bare metal to the top of the remaining paint film. Featheredging hides the depressions from new paint. The tapered edge is called the "featheredge."
8. **Grit** - a measure of the abrasive quality of sandpaper: The higher the number, the finer the grit.
9. **Masking** - (1) the paper or tape that covers areas on a surface that are not to be painted; (2) the process of shielding areas with masking material.
10. **Moldings** - grilles, window trim pieces, metal or rubber strips on the side of a vehicle, etc.

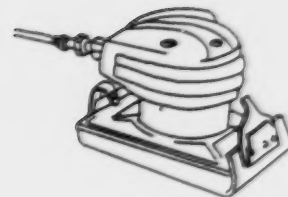
11. **Open coat abrasive paper** - a sandpaper on which the surface grains are spaced to cover between 50 and 70 percent of the paper backing.
12. **Sand scratches** - marks left on the paint from sandpaper.
14. **Scuff sanding** - a process that uses a very fine grit sandpaper to "rough up" the finish.
15. **Substrate** - ("sub" = under, "strate" = level) an undercoat or level of paint below new paint.
16. **Trim** - pieces on the surface of a vehicle that are used to make it prettier, stronger or more comfortable. Trim may be found on the interior or exterior. Examples: bumper covers, door handles, mirrors, etc.

B. EQUIPMENT

1. **Random orbital sander** - power tool used for light sanding of small areas.



2. **Orbital-reciprocating sander** - power tool used to level and smooth old paint or plastic filler.



3. **Oscillating sander** - any orbital or reciprocating sander.

4. **Putty knife** - hand tool used to remove paint and cement.



5. **Sanding block** - wooden tool used when hand sanding.



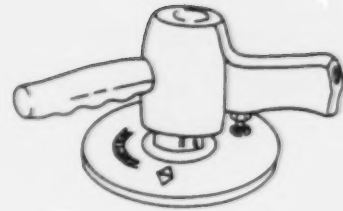
6. **Squeegee** - hand tool used to rake water off of the vehicle when wet sanding.



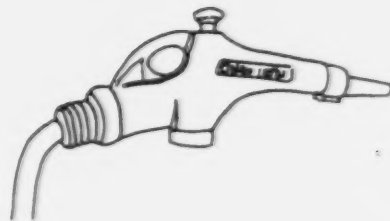
7. **Wire brush** - hand tool used to remove rust and old paint from vehicles.



8. **Grinder** - power tool used to (1) level a repaired area, (2) smooth scars left from body repair, and (3) rough the surface before filler is applied.



9. **Blow gun** - the nozzle attached to an air compressor hose and used to blow dust and dirt from cracks on the surface of a vehicle.



C. SANDING SAFETY

1. ALWAYS make sure (1) the sander is in good condition, (2) properly grounded and (3) the power cord is in good condition.
2. NEVER stand in or near water when using an electrical sander.
3. ALWAYS unplug the sander (1) when it is not in use and (2) when changing sandpaper.
4. ALWAYS wear safety glasses.
5. NEVER wear loose clothing or hanging jewelry (necklaces, etc.).
6. ALWAYS keep long hair in a hair net or under a cap.

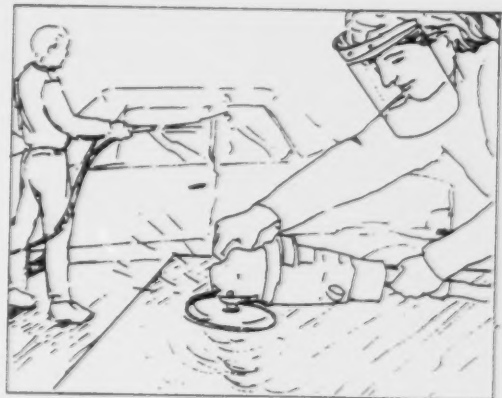


7. **NEVER** stop the sander with your hand.

8. **ALWAYS** follow directions from the manufacturer and your teacher.



9. **ALWAYS**, when standing or kneeling and using a power sander, be sure (1) your body is steady and balanced and (2) you keep a firm grip on the sander.



D. ABRASIVES

An "abrasive" is something that uses friction to rub away a surface. Sandpaper is the most common abrasive. The two most common kinds of sandpaper used in a body shop are: (1) aluminum oxide and (2) silicon carbide.

Sandpaper's roughness is measured in "grits." The grit size is printed on the back of the sandpaper. The kind and grit of sandpaper depend on the job.

AUTO BODY
SANDING TECHNIQUES

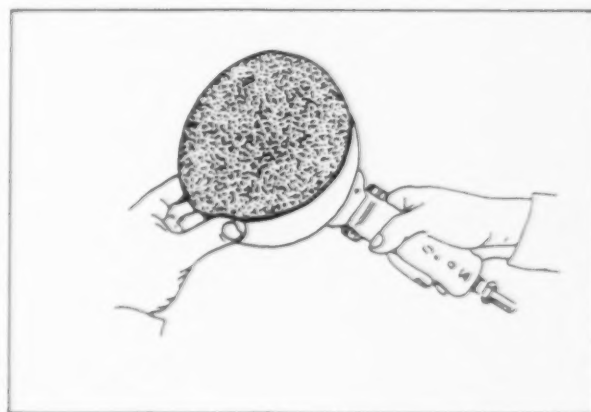
1. Aluminum oxide sandpaper is used for dry sanding operations. It is not waterproof.

2. Silicon carbide sandpaper is used for wet sanding.

3. The grit of sandpaper indicates its coarseness. The lower the number, the more coarse the sandpaper. For example, a 16-grit sandpaper is more coarse than a 50-grit.

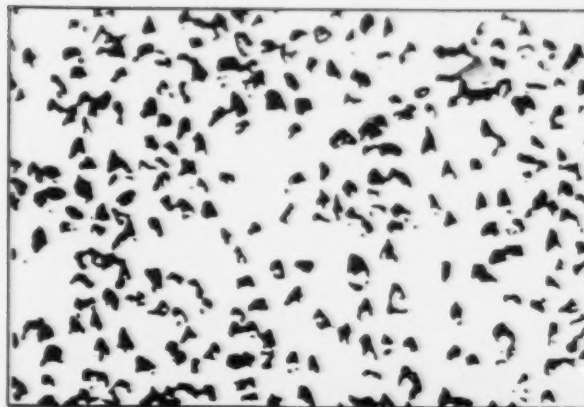
4. Grit sizes range from 16 to 2000.

5. When dry sanding, you use grits of 36 to 400. Grits for grinding discs are usually 16, 24, 36 and 50.



6. When wet sanding, you use grits of 220 to 2000.

7. Open coat sandpaper has sanding grains that cover 50 to 70 percent of the paper's surface.



8. Closed coat sandpaper has sanding grains that cover the whole surface (100 percent) of the paper.



DO SKILL SHEET 1

DO ACTIVITY SHEET 1

SANDING TECHNIQUES
SKILL SHEET 1

Directions: Match the definitions on the left with the words on the right by putting the letter of the word beside its definition.

- | | |
|---|---------------------|
| _____ 1. Kind of sandpaper used
when dry sanding | A. Abrasive |
| | B. Wet sanding grit |
| _____ 2. 36- to 400- grit sand-
paper | C. Dry sanding grit |
| _____ 3. Indicates the coarseness
of the sandpaper | D. Aluminum oxide |
| | E. Silicon carbide |
| _____ 4. Uses friction to wear
away a surface | F. Grit |
| _____ 5. Kind of sandpaper used
when wet sanding | |
| _____ 6. 220- to 2000-grit sandpaper | |

7. - 10. Put the following grits in order according to coarseness. Number seven should be the coarsest grit.

160-grit 600-grit 16-grit 320-grit

7.

8.

9.

10.

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SANDING TECHNIQUES
ACTIVITY SHEET 1

Directions: Using sandpaper provided by your teacher, put the pieces of sandpaper in order from coarsest to finest. (Number 1 will be the coarsest.)

- _____ 1.
- _____ 2.
- _____ 3.
- _____ 4.
- _____ 5.
- _____ 6.

Directions: Using pieces of sandpaper provided by your teacher, tell which piece is:

- _____ 7. sandpaper used for dry sanding
- _____ 8. grinding disc used for dry sanding
- _____ 9. sandpaper used for wet sanding
- _____ 10. grinding disc used for wet sanding

E. USING AN ORBITAL RECIPROCATING OR ORBITAL DISC SANDER

1. Equipment:

(1) Orbital reciprocating sander
and sandpaper

or: (2) Orbital disc sander
and sanding disc

Non-oil detergent

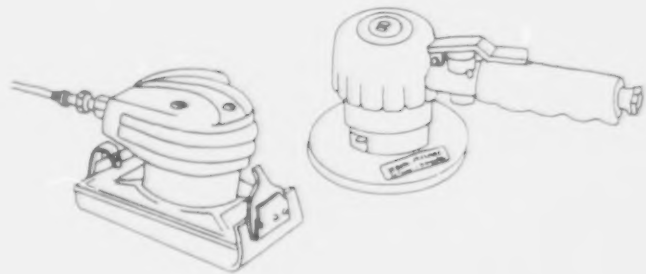
Masking material

Wax and grease remover

Blow gun

Clean rags

Protective clothing and equipment



2. Wash the vehicle or panel with
non-oil detergent.

3. Prepare the area to be painted
by applying wax and grease
remover.



4. Remove trim, emblems and moldings. Put them in a safe place.

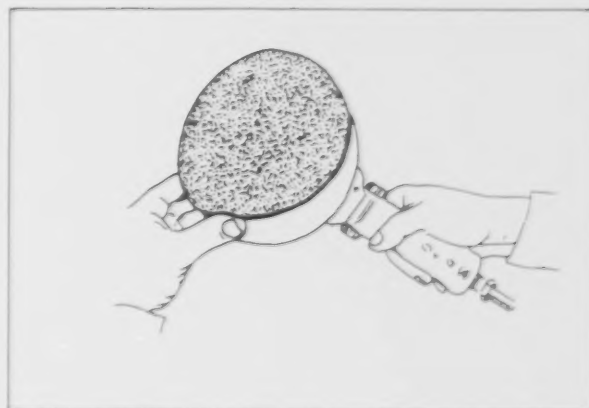
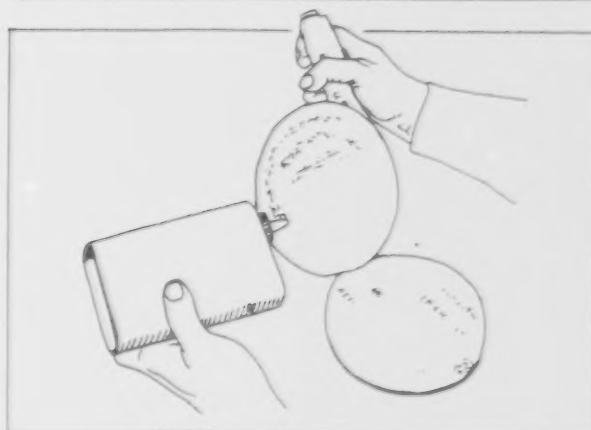
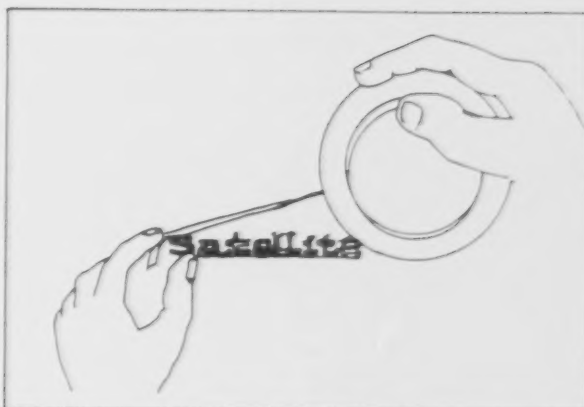
5. Mask trim, emblems and moldings that you cannot remove.

6. Apply proper sandpaper or sanding disc to sander.

NOTE: After the sander is on, use just enough pressure to control movement.

7. Move the sander back and forth until sanding is completed.

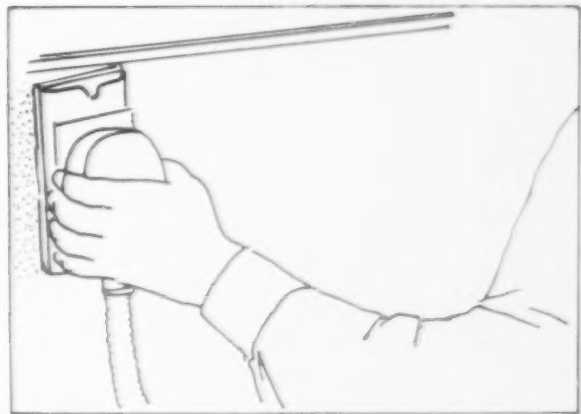
NOTE: Keep the sander moving at all times. This will prevent sanding



AUTO BODY SANDING TECHNIQUES

in one spot too long, which can cause a low spot.

CAUTION: You must be very careful to hold the orbital disc sander flat against the vehicle's surface.



8. Wipe or blow the area dry.
Check your progress by running your hand over the area.
9. Apply a finer grit of paper and repeat the process.

NOTE: If you are going to apply enamel paint, the second sanding requires a 320- or 400-grit paper. If a lacquer finish is to be applied, the second sanding requires a 500- or 600-grit paper.

10. Hand sand.

DO ACTIVITY SHEETS 2 AND 3

SANDING TECHNIQUES
ACTIVITY SHEET 2

Orbital Reciprocating Sander

Equipment:

Orbital reciprocating sander	Sandpaper
Non-oil detergent	Wax and grease remover
Masking material	Clean rags
Protective clothing and equipment	

Procedure:

Evaluation

	3	2	1	N
1. Wash vehicle with detergent and water	-	-	-	-
2. Wash with wax and grease remover	-	-	-	-
3. Remove trim, moldings and emblems	-	-	-	-
4. Mask remaining trim	-	-	-	-
5. Select proper sandpaper	-	-	-	-
6. Sand properly	-	-	-	-
7. Check sanded area	-	-	-	-
8. Repeat process	-	-	-	-

9. Hand sand

10. Observe safety rules

SANDING TECHNIQUES
ACTIVITY SHEET 3

Orbital Disc Sander

Equipment:

Orbital disc sander	Sanding disc
Non-oil detergent	Wax and grease remover
Masking material	Clean rags
Protective clothing and equipment	

Procedure:

Evaluation

3 2 1 N

- | | | | | |
|--|---|---|---|---|
| 1. Wash vehicle with detergent and water | — | — | — | — |
| 2. Wash with wax and grease remover | — | — | — | — |
| 3. Remove trim, moldings and emblems | — | — | — | — |
| 4. Mask remaining trim, moldings and emblems | — | — | — | — |
| 5. Select proper sanding disc and paper | — | — | — | — |
| 6. Sand properly | — | — | — | — |
| 7. Check sanded area | — | — | — | — |
| 8. Repeat process | — | — | — | — |

9. Hand sand

10. Observe safety rules

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F. GRINDER SAFETY RULES

1. ALWAYS grind in a well ventilated area because grinding causes a great deal of dust.
2. ALWAYS wear safety goggles with clear lenses. Make sure people nearby are wearing safety goggles.
3. ALWAYS wear a particle mask.
4. NEVER hold the grinder flat against the surface. Holding it flat may cause it to jerk and injure you or damage the vehicle.



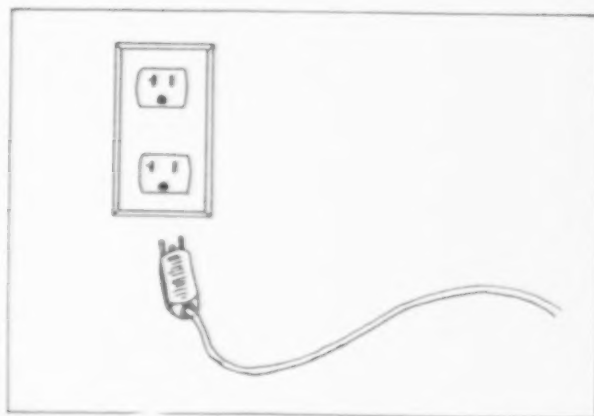
5. NEVER turn the grinder (1) on when it is close to the surface or (2) off when it is touching the surface.

6. ALWAYS check equipment for safety before plugging it in.



7. ALWAYS follow the directions of the manufacturer and your teacher.

8. NEVER change the disc when the grinder is connected to the power source.

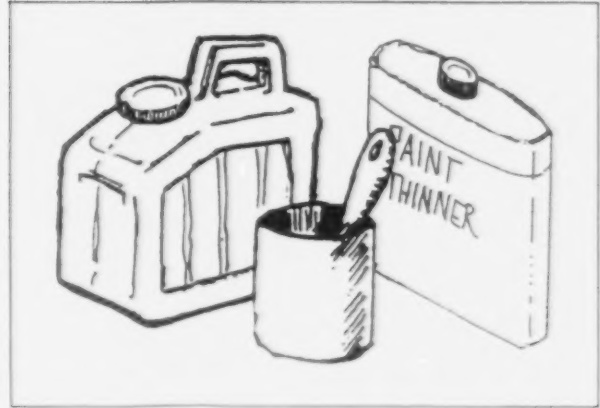


9. ALWAYS lay the grinder on the floor only after it has completely stopped.

AUTO BODY
SANDING TECHNIQUES

10. NEVER grind near flammables (paint thinners, reducers or gas tank openings).

11. ALWAYS make sure your grip on the grinder is firm and your body position is stable and balanced.



G. USING GRINDERS

1. Equipment:

Protective clothing and equipment

Sandpaper

Masking material

Non-oil detergent

Grinder

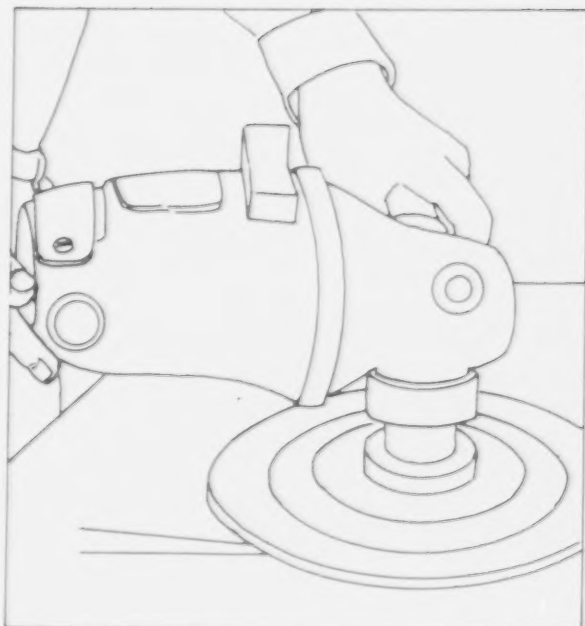
Grinding disc

Wax and grease remover

Blow gun

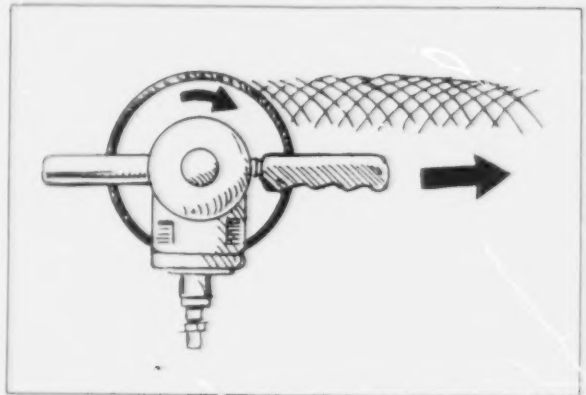
2. Wash the vehicle or panel with non-oil detergent.

3. Apply wax and grease remover to the area being painted.
4. Remove trim, emblems and moldings. Put them in a safe place.
5. Carefully mask trim, emblems and moldings that cannot be removed.
6. Put the proper disc on the grinder.
7. Using both hands, hold the disc of the grinder at about a five-degree angle to the surface. About one inch of the grinder's grit surface should touch the vehicle.



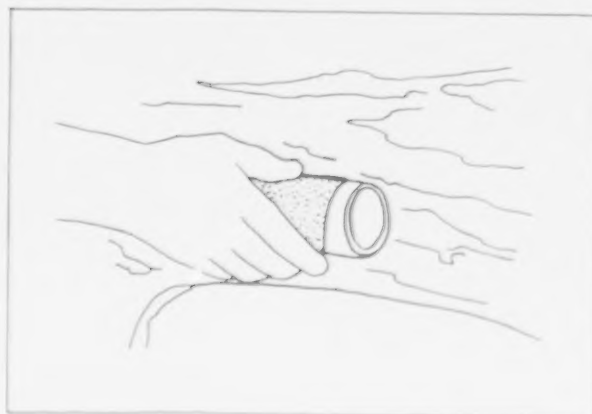
AUTO BODY
SANDING TECHNIQUES

8. Put moderate pressure on the grinder.
9. Overlap strokes as you move over the area to be repaired.
10. Turn off the grinder and unplug it.
11. Wipe the area with a cloth or blow it with the blow gun.
12. Put a finer disc on the grinder for a second sanding.
13. Plug in the grinder, turn it on, and grind the area again.
14. After you finish grinding again, turn off the grinder and unplug it.



15. Wipe the area or blow it with the blow gun.

16. Check your progress and hand sand spots you couldn't reach with the grinder.



NOTE: Don't throw the used disc's paper away. Its worn edges may be trimmed off to use it on a smaller disc.

DO SKILL SHEET 2

DO ACTIVITY SHEET 4

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SANDING TECHNIQUES

SKILL SHEET 2

Directions: Put a "T" in front of statements that are true. Put an "F" in front of statements that are false.

- ___ 1. Grinders should be held at about a five-degree angle to the surface.
- ___ 2. About three inches of the grinder's grit surface should contact the vehicle.
- ___ 3. All emblems, moldings and trim should be removed before refinishing begins.
- ___ 4. The orbital reciprocating sander should be moved in a circular motion.
- ___ 5. Sanders should be kept moving on the surface at all times.
- ___ 6. Grinders should never be held flat against the vehicle's surface.

- ___ 7. Orbital sanders should never be held flat against the vehicle's surface.
- ___ 8. It is important to overlap strokes when using a grinder.
- ___ 9. A blow gun may be used to remove residue from the surface.
- ___ 10. Hand sanding does not need to be done if a power tool is used.

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SANDING TECHNIQUES
ACTIVITY SHEET 4

Grinding

Equipment:

Protective clothing and equipment	Grinder
Grinding disc	Sandpaper
Non-oil detergent	Wax and grease remover
Masking material	Clean rag
Blow gun	

Procedure:

	Evaluation			
	3	2	1	N
1. Wash vehicle with non-oil detergent	—	—	—	—
2. Wash with wax and grease remover	—	—	—	—
3. Remove trim, molding and emblems	—	—	—	—
4. Mask remaining trim, molding and emblems	—	—	—	—
5. Select proper disc	—	—	—	—
6. Hold grinder in correct position	—	—	—	—
7. Use grinder properly	—	—	—	—
8. Clean residue	—	—	—	—

9. Check progress

10. Repeat process

11. Hand sand

12. Observe safety rules

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H. HAND SANDING

1. Equipment:

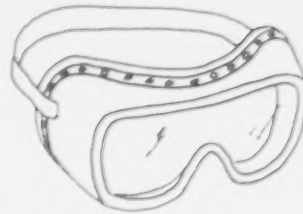
Sanding block

Sandpaper

Safety glasses

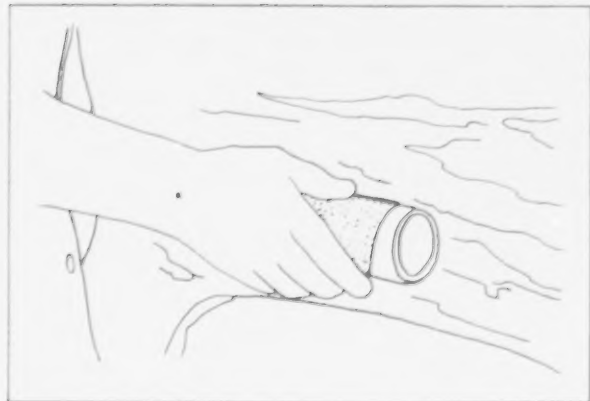
Flexible hose or pad

ALWAYS WEAR
SAFETY GLASSES
WHEN HAND SANDING.



- ### 2. Put the sandpaper on the sanding block.

NOTE: If sanding a convex or concave surface, sandpaper should be put on a flexible hose or pad that fits the surface.

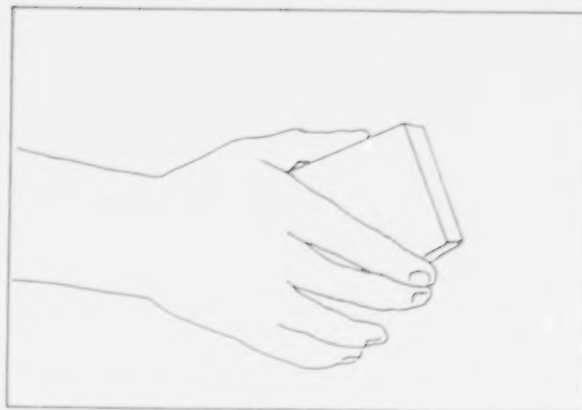


- ### 3. When hand sanding, position your fingers so you can put even pressure on the surface.
- If your fingers are spread, or if



uneven pressure is applied,
the paper will leave marks.

4. When sanding with a block or by hand, begin sanding an area of 12 to 18 inches.
5. Sand in a back-and-forth motion. Sand in a straight line.



NOTE: Never sand in a circular motion.

NOTE: Do not sand on the same area for a long time. This can cause a low spot.

DO SKILL SHEET 3

DO ACTIVITY SHEET 5

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SANDING TECHNIQUES

SKILL SHEET 3

Directions: Place the letter of the correct answer in the blank space.

- ___ 1. Hand sanding should be done in a(n)
a. circular motion. b. up-and-down motion.
c. back-and-forth d. a, b and c
motion.
- ___ 2. A sanding block is used on a
a. flat surface. b. concave surface.
c. convex surface. d. a, b and c
- ___ 3. When using a sanding block, your fingers should be positioned so
they are
a. spread apart. b. close together.
c. forming uneven d. none of the above
pressure.

___ 4. The sanding area should be

- a. 4-6 inches.
- b. 12-18 inches.
- c. the length of the panel.
- d. 20-24 inches.

___ 5. Sanding on the same area for a long time can cause

- a. hot spots.
- b. peaks.
- c. a low spot.
- d. heat damage.

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SANDING TECHNIQUES
ACTIVITY SHEET 5

Hand Sanding

Equipment:

Sanding block

Flexible hose or pad (optional)

Sandpaper

Safety glasses

Procedure:

Evaluation

3 2 1 N

1. Select proper sandpaper
2. Apply sandpaper to block or pad
3. Position fingers properly
4. Sand properly

— — — —
— — — —
— — — —
— — — —

I. FEATHEREDGING

1. Equipment:

Protective clothing and equipment

Sanding block

Sanding disc

Wax and grease remover

Sponge

Sandpaper

Disc sander

Non-oil detergent

Container of water

Squeegee

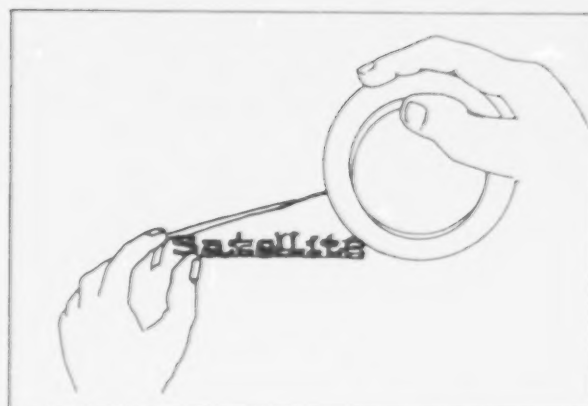
2. Using non-oil detergent, wash the vehicle or panel.

3. Using wax and grease remover, wash the vehicle or panel.

4. Remove trim, emblems and moldings. Put them in a safe place.

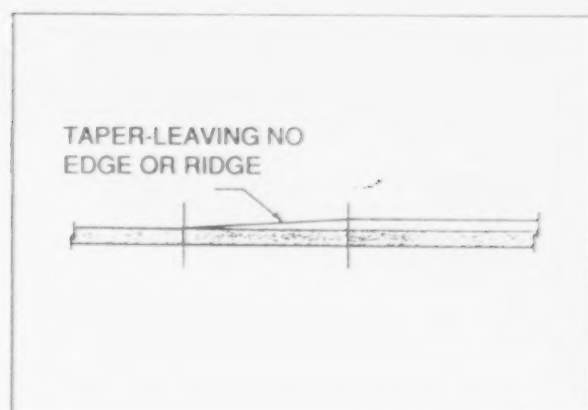


5. Carefully mask the remaining trim, emblems and moldings.
6. Put 180-grit paper on the sander.

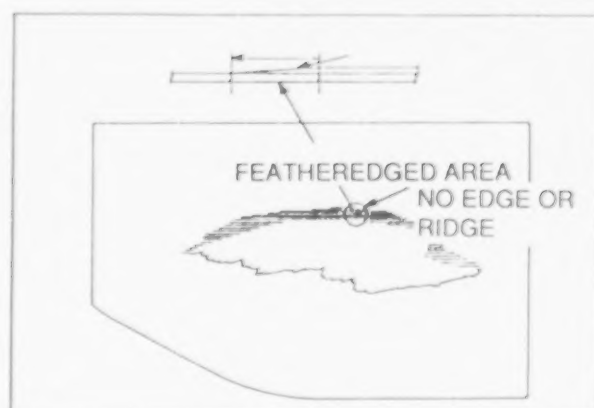


NOTE: Grit size may vary.

7. Place the sander on the area to be featheredged and move the sander around the area until all edges are straight.



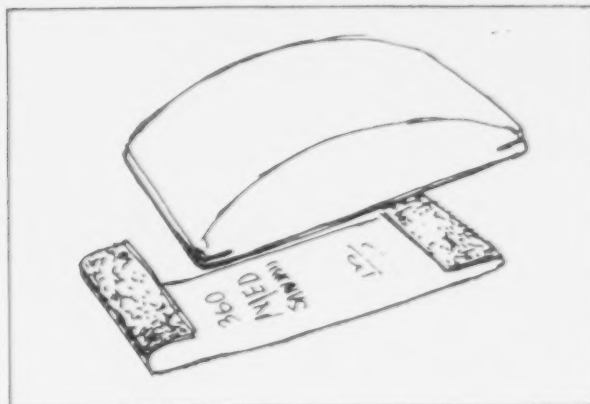
8. Check your progress.
9. Put 220-grit paper on the sanding block and sand the area again.



NOTE: Grit size may vary.

**AUTO BODY
SANDING TECHNIQUES**

10. Check your progress.
11. Put 360- or 400-grit paper on the sanding block.
12. Do wet hand sanding.



DO SKILL SHEET 4

DO ACTIVITY SHEET 6

SANDING TECHNIQUES
SKILL SHEET 4

Directions: Put a "T" in front of statements that are true. Put an "F" in front of statements that are false.

_____ 1. 220-grit paper is used during the first sanding.

_____ 2. Wet sanding is done with an orbital sander.

_____ 3. 360- or 400-grit paper is used to wet sand.

_____ 4. Grit sizes never vary.

_____ 5. Wet sanding is done first.

SANDING TECHNIQUES
ACTIVITY SHEET 6

Featheredging

Equipment:

Protective clothing and equipment	Disc sander
Sanding disc	Sandpaper
Sanding block	Bucket and water
Squeegee	Non-oil detergent
Wax and grease remover	Sponge

Procedure:

	Evaluation			
	3	2	1	N
1. Wash vehicle or panel with non-oil detergent	—	—	—	—
2. Wash vehicle or panel with wax and grease remover	—	—	—	—
3. Remove trim, emblems and moldings	—	—	—	—
4. Mask remaining trim, emblems and moldings	—	—	—	—
5. Put paper on disc properly	—	—	—	—
6. Complete featheredging	—	—	—	—

7. Re-sand using finer grit paper

8. Wet sand

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J. WET SANDING

NEVER use an electric sander when wet sanding.

ALWAYS wet sand with an air powered sander or sand by hand.

ALWAYS beware of a wet floor when wet sanding. Water makes a floor slick.

1. Equipment:

Squeegee	Bucket
Sponge	Sandpaper

2. Place a bucket of water near the vehicle.

3. Squeeze water from the sponge onto the surface of the vehicle.

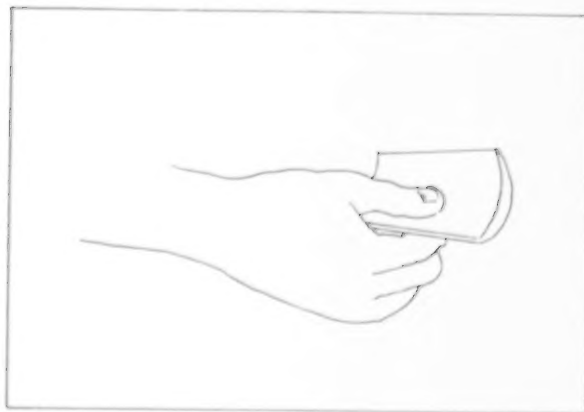


4. Begin sanding.

5. As you sand, use (1) the sponge to squeeze out clean water with which you rinse the

surface, and (2) the squeegee to rake excess water from the surface.

6. Check for low places on the surface. Water will stand in these places.



NOTE: Be careful not to get masking tape or paper wet.

DO SKILL SHEET 5

DO ACTIVITY SHEET 7

SANDING TECHNIQUES
SKILL SHEET 5

Directions: Place the letter of the correct answer in the blank space.

- ___ 1. Which sanding tool should NOT be used when wet sanding?
- a. sanding block
 - b. pneumatic sander
 - c. electric sander
 - d. none of the above
- ___ 2. Water standing on the surface after you have used the squeegee means
- a. there's a low spot on the surface
 - b. the surface was improperly filled.
 - c. more grinding is needed.
 - d. nothing. Everything is O.K.
- ___ 3. A squeegee
- a. absorbs water off the surface.
 - b. rakes water from the surface.
 - c. puts water on the surface.
 - d. none of the above.

___ 4. Water is put on the vehicle with a

- a. hose.
- b. sanding block.
- c. sponge.
- d. spray gun.

___ 5. Care should be taken not to

- a. rinse too often.
- b. use too much water.
- c. get masking material wet.
- d. none of the above

200

SANDING TECHNIQUES
ACTIVITY SHEET 7

Wet Sanding

Equipment:

Squeegee	Sanding block
Bucket	Water
Sponge	Sandpaper

Procedure:

Evaluation

3 2 1 N

1. Squeeze water onto surface
2. Sand in proper manner
3. Rinse properly
4. Rake water from the surface
5. Check for low spots

-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

SANDING TECHNIQUES

UNIT TEST

Directions: Match the term in the right column with the correct definition in the left column.

- | | |
|--|------------------|
| ___ 1. A substance used to wear away a surface by friction | A. Abrasive |
| | B. Cleaning |
| | C. Grit |
| ___ 2. Sanding beyond the featheredged area | D. Emblems |
| | E. Back sanding |
| ___ 3. Preparing the surface for painting | F. Featheredging |
| ___ 4. Name plates and hood ornaments | |
| ___ 5. Tapering a broken edge to bare metal | |
| ___ 6. The abrasive coating on sandpaper | |

- ___ 7. Applying masking paper and/or tape to shield areas that are not to be painted
- ___ 8. Grilles, window trim pieces, metal or rubber strips on the side of a vehicle
- ___ 9. Marks left on the paint from the sandpaper
- ___ 10. Roughing up the finish with a very fine grit paper
- ___ 11. Surface under new paint
- ___ 12. Bumper covers, door handles and mirrors
- A. Sand- scratches
- B. Moldings
- C. Trim
- D. Scuff sanding
- E. Substrate
- F. Masking

Directions: Place the letter of the correct answer in the blank space.

- ___ 13. The correct angle at which grinders should be held to the surface is
- a. 10 degrees. b. 8 degrees.
- c. 5 degrees. d. 12 degrees.

AUTO BODY
SANDING TECHNIQUES

- ___ 14. Hand sanding should be done with a(n)
- a. circular motion.
 - b. up-and-down motion.
 - c. back-and-forth
 - d. a, b and c motion.
- ___ 15. When using a sanding block, fingers should be positioned so they are
- a. spread apart.
 - b. close together.
 - c. forming uneven
 - d. none of the above pressure.
- ___ 16. Sanding blocks are used on a
- a. flat surface.
 - b. concave surface.
 - c. convex surface.
 - d. a, b and c
- ___ 17. Which of the following tools should NOT be used when wet sanding?
- a. sanding block
 - b. pneumatic sander
 - c. electrical sander
 - d. none of the above.
- ___ 18. The number on the back of a piece of sandpaper indicates
- a. its coarseness.
 - b. the supplier.
 - c. its inventory place.
 - d. none of the above

- ___ 19. Aluminum oxide is used for
- a. wet sanding.
 - b. dry sanding.
 - c. wet and dry sanding.
 - d. masking.
- ___ 20. Grinding near flammables may cause
- a. electric shock.
 - b. an explosion.
 - c. breathing problems.
 - d. none of the above
- ___ 21. When washing a vehicle, you should use
- a. a petroleum based detergent.
 - b. non-petroleum detergent.
 - c. chemical stripper.
 - d. spit.

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- ___ 22. A wax and grease remover should be used on vehicles before refinishing techniques are started.
- ___ 23. About two inches of the grinder's grit surface should contact the vehicle.

SANDING TECHNIQUES

- ___ 24. The orbital reciprocating sander should be moved in a back-and-forth motion.
- ___ 25. Before you move a sander, you should hold it in one spot on the surface for five minutes.
- ___ 26. Sandpaper grits range from 0 to 1500.

Directions: List five general safety rules to observe while working in the auto body lab.

27.

28.

29.

30.

31.

SANDING TECHNIQUES
PERFORMANCE CHECKLIST

Student _____ successfully performed the
following tasks:

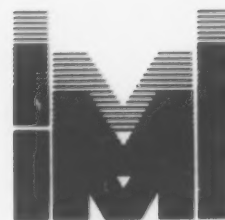
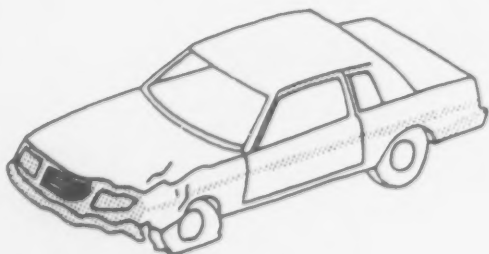
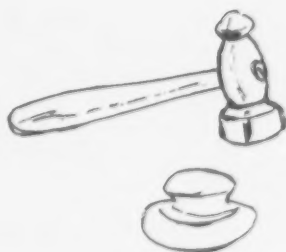
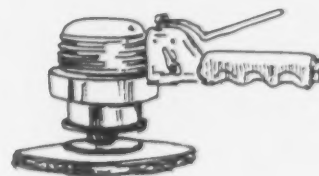
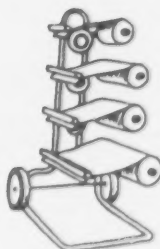
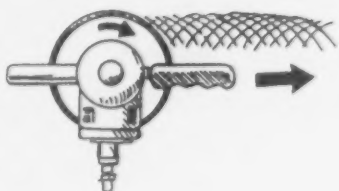
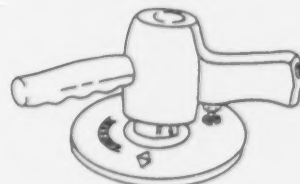
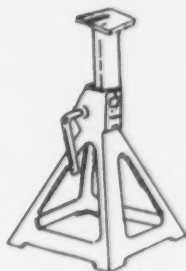
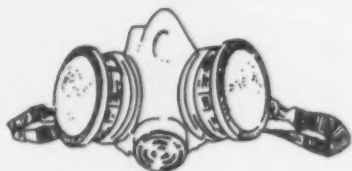
	Yes	No	Comments
1 Defined 16 auto body words associated with sanding.			
2 Identified various abrasives and grit sizes.			
3. Followed auto body shop safety rules.			
4. Selected the proper tools and equipment for dry sanding, wet sanding and featheredging.			
5. Demonstrated the techniques of dry sanding, wet sanding and featheredging.			

Satisfactory -- should move on _____
Should repeat this unit _____

Student's signature/Date _____

Instructor's signature/Date _____

PRIMERS AND GUIDECOATS



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

PRIMERS AND GUIDECOATS

INTRODUCTION

Choosing the correct primer is important. The primer (1) fills, (2) seals, (3) prevents rust, corrosion or scratches and (4) helps paint stick to the car's surface.

UNIT OBJECTIVE

After completing this unit, you should be able to apply a primer and a guidecoat.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Define 14 words used with primers and guidecoats.
2. Identify six tools used with primers and guidecoats.
3. Follow auto body shop safety rules in applying primers.
4. Apply primers to the satisfaction of the instructor.
5. Apply guidecoats to the satisfaction of the instructor.

Check the Statement that Fits You Best.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

A. TERMS

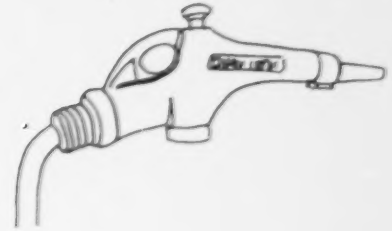
1. **Activator** - a substance that is mixed with another material to make it work. In this unit, the activator is used to make epoxy primer work.
2. **Adhesion** - the act of sticking or attaching. When paint "adheres" to a panel, the paint sticks to the panel.
3. **Bleeding** - occurs when a new color coat sinks through the primer material.
4. **Corrosion** - a process in which a metal or other object is slowly eaten or worn away by rust or by the action of chemicals.
5. **Flash-off** - the initial stage of paint drying time. During flash-off, some of the solvent evaporates and dulls the paint so it isn't as glossy.
6. **Guidecoat** - a primer of a different color that is sprayed over a sanded primer surfacer. After the guidecoat is sanded, the different colors reveal problems with the surface.
7. **Primer** - an undercoating material used to promote adhesion and to prevent corrosion.
8. **Reducer** - a liquid that mixes with enamel and thins it.
9. **Solvent** - a substance, usually a liquid, that can dissolve another substance.
10. **Tack rag** - a chemically treated cloth used to remove dust from a car's surface just before painting.
11. **Thinner** - a liquid that mixes with lacquer and reduces it.
12. **Topcoat** - the final color coat.

13. **Undercoat** - layers of paint material such as primer used to provide a smooth adhesive, properly sealed and corrosion-free base for color coats.
14. **Vehicle** - a substance mixed with paint that helps the paint stick to a surface.

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B. EQUIPMENT

1. **Blow Gun** - attached to the air compressor hose; used to blow dust and dirt from cracks and the surface of a car.



2. **Buffer** - a power tool with a rotating soft pad; used to apply rubbing compound.



3. **Paint paddle** - a metal, wood or plastic stick; used to mix paint.



4. **Paint strainer** - a funnel-shaped device; used to strain out dirt, scum or other impurities in paint as the paint is poured into a spray gun.



5. **Siphon-feed spray gun** - a paint spray gun that uses compressed air to move the paint through the gun.



6. **Viscosity cup** - a device that allows the painter to measure the thickness (viscosity) of paint by measuring the time paint takes to drip through.



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C. INFORMATION ON PRIMERS

Primers help the topcoat adhere (stick) to the surface. They protect bare metal from rust and make the topcoat last longer.

Primers are mainly used on new or replacement panels. When you use a good primer, you don't usually have to sand the topcoat.

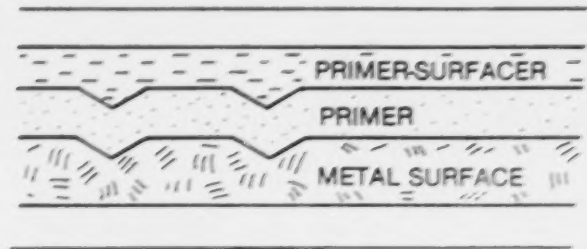
Primers have small solid particles in them that create a rough surface for the later paint to stick to. While primers create a rough surface, they should not be used over an already rough surface.

You apply primers in thin coats. If there are flaws in the primer, you will need to sand the surface with a fine-grit sandpaper.

TWO KINDS OF PRIMERS

Primers are divided into two groups:

(A) nonsanding primers and (B) sanding primers (primer surfacers).



1. **Nonsanding** primers do not need to be sanded before the topcoat is applied **UNLESS** dust or dirt has settled on the surface. Although nonsanding primers can fill in small scratches, they do not really make good fillers.

There are several kinds of nonsanding primers.

a. **Primer sealer**, which seals the undercoat. Sealer keeps the undercoat from bleeding (showing) through the finish coat.

You use primer sealer over old finishes or as a basecoat for enamel finishes.

b. **Zinc chromate**, which is used on metals that do not contain iron, such as steel and

aluminum. Zinc chromate may be used on truck bodies. **THIS PRIMER IS VERY TOXIC!** You must observe safety rules when using zinc chromate.

c. **Wash primer**, which is used on metals that do or do not contain iron. Wash primer provides a very good bond for paint. Wash primers are not good fillers. They are usually applied once over the surface for bonding purposes.

d. **Epoxy primer**, a very useful two-part primer system. It consists of the primer itself and an activator (called a catalyst) that makes the primer work. Epoxy primers are a good choice where a great deal of fill is needed.

On sandblasted, coarse surfaces, for example, epoxy

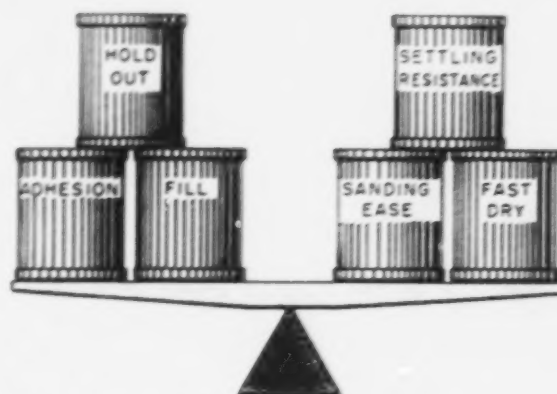
primer provides the fill necessary for a smooth finish.

2. Sanding primers (also called primer surfacers) must be sanded before you apply a topcoat. The surfacer part of the primer should not separate from the primer, or the liquid will not spread evenly. A good primer seals well.

Sanding primers come in synthetic enamel and lacquer types. Both make good fillers.

Lacquer dries faster than enamel, but enamel lasts longer. If scuff sanding is needed, steel wool or 400-grit paper is used.

You apply the primer surfacers in a series of coats. It will usually take four to six coats. Allow each coat to "flash-off" before you apply the next coat. Sanding is needed after each coat.



THESE PROPERTIES
BUILD THE RIGHT
FOUNDATION FOR
THE TOPCOAT

THESE PROPERTIES
MAKE THE JOB
FAST AND EASY

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a. Enamel primers can be used only with enamel topcoats. An enamel primer will last longer and will prevent rust better than a lacquer primer. Enamel primers are used on large bare metal areas, as in complete refinishing jobs.

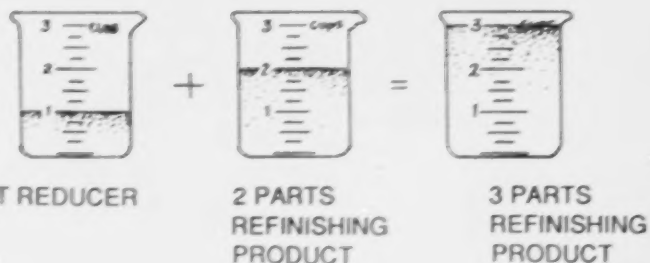
If wet sanding is to be done, enamel primers should be allowed to dry overnight.

NOTE: If moisture is trapped under the coat, blistering or bubbling will occur on the color topcoat.

b. Lacquer primer can be used under a lacquer or enamel topcoat or over either. Lacquer primers are used mainly for spot repair. You may be able to sand in 20 to 30 minutes, depending on the temperature and humidity.

Sanding is easy if you have applied the lacquer primer correctly.

3. Mixing is a very important stage in the process of applying primers. Primers usually need to be thinned before you use them. ALWAYS follow the manufacturer's directions closely! Below is an example of instructions for a finished product:



NOTE: "Reducer" thins enamel.
"Thinner" thins lacquer.

KIND OF THINNER	RATIO	SURFACE AREA
Mid-temp or Low-temp	1 part reducer to 2 parts refinishing product	Spot Repair

AIR PRESSURE IN
SPRAY GUN
35 - 40 psi

C. SAFETY RULES FOR USING PRIMERS

1. **ALWAYS** do priming work in a well ventilated area.

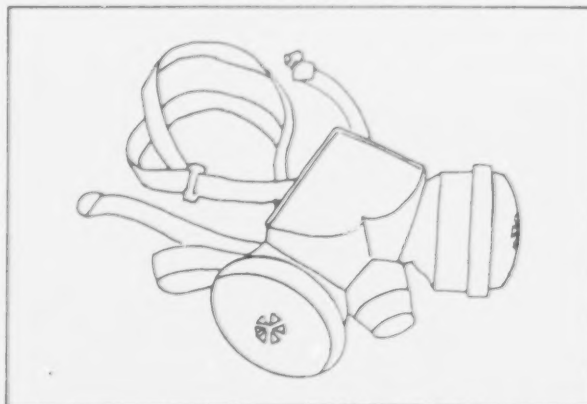
2. **DO NOT SMOKE!**

3. **DO NOT** weld or grind in the priming area while priming work is going on. Welding and grinding should stop until priming is done and fumes have disappeared. **Thinners and reducers are very explosive!**

4. **DO NOT** spill reducers or thinners. Their fumes are explosive.

5. You **MUST** wear a respirator. The fumes contain poisonous chemicals.

6. **ALWAYS** Wear safety goggles to protect your eyes from particles and paint overspray.



7. Wear rubber gloves.
8. Store all containers properly—
AWAY FROM work being done
in the lab.
9. Put wiping cloths in a covered
metal container.
10. Dispose of empty containers
right away.



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E. PROCEDURES FOR APPLYING PRIMERS

1. Equipment:

Proper primer

Eye protection

Paint gun

Paint paddles

Masked vehicle (car)

Sanding block

Viscosity cup

Proper thinner or reducer

Recommended respirator

Proper sandpaper

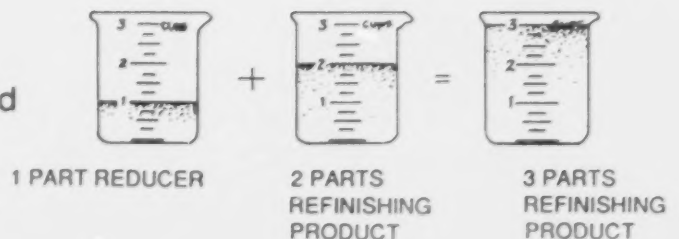
Strainer

2. Perform proper sanding and masking operations.

3. Put on eye protection and respirator.

4. Stir primer with paint paddle.

5. Mix primer to recommended percentage.



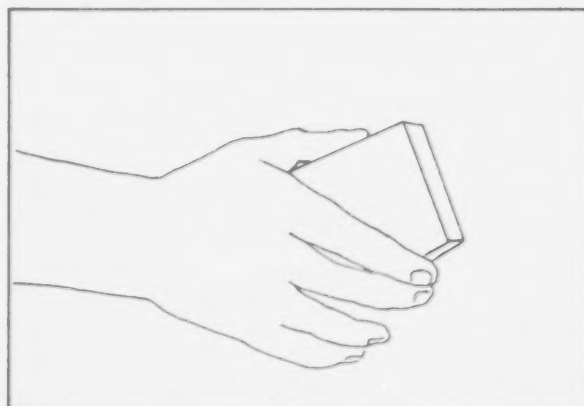
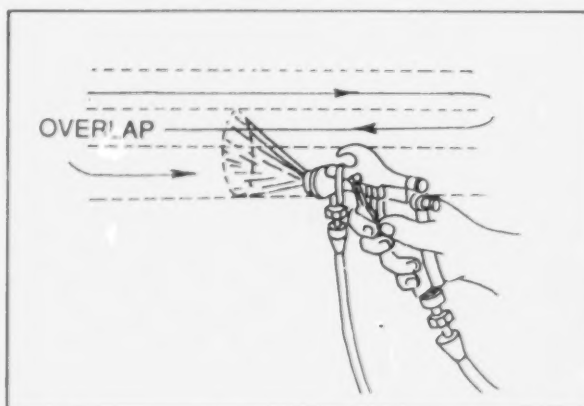
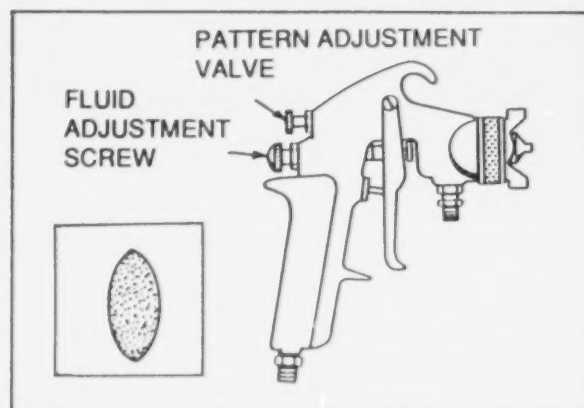
NOTE: Follow ALL instructions and cautions on the label.

6. If needed, strain mixed primer.

7. Adjust spray gun to correct pattern. Adjust pressure at gun to recommended pressure.

NOTE: This information is often found on the label directions.

8. Use alternate right and left strokes. Release trigger at the beginning and end of each stroke.
9. Apply one coat.
10. Allow primer to dry or flash off for the recommended time.
11. Inspect area for flaws.
12. Sand with a sanding block if necessary.
13. Repeat until you've applied the recommended number of coats.



DO SKILL SHEET 1
DO ACTIVITY SHEET 1

PRIMERS AND GUIDECOATS

SKILL SHEET 1

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- ___ 1. Primers are used to protect bare metal from rust.
- ___ 2. Lacquer primer dries faster than enamel primer.
- ___ 3. A primer sealer is a good filler.
- ___ 4. Epoxy primers are good to use over rough, sand-blasted areas.
- ___ 5. Lacquer primers are used mainly for spot repairs on panels.
- ___ 6. Workers should not smoke when using thinners or reducers.

Directions: Select and circle the best answer.

- ___ 7. Enamel primers should be used with which topcoat?
- a. lacquer
 - b. enamel
 - c. epoxy
 - d. all of the above
- ___ 8. If wet sanding is to be done, enamel primers should dry overnight to prevent
- a. rusting.
 - b. cracking.
 - c. blistering.
 - d. flash-off.
- ___ 9. Lacquer primers may be used under a(n)
- a. lacquer top.
 - b. enamel top.
 - c. plastic top.
 - d. lacquer and/or enamel top.
- ___ 10. Lacquer primer-surfacers are used mainly for
- a. spot repair.
 - b. panel repair.
 - c. entire refinishing jobs.
 - d. all of the above.
- ___ 11. Enamel primers should be used with which topcoat?
- a. lacquer
 - b. enamel
 - c. epoxy
 - d. all of the above

- ___ 12. Spraying primers should NOT be done
- a. near welding operations.
 - b. near grinding operations.
 - c. in a poorly ventilated area.
 - d. all of the above.
- ___ 13. Which of the following safety equipment is NOT necessary when using primers, primer-surfacers or sealants?
- a. eye protection
 - b. respirator
 - c. rubber gloves
 - d. drill press

PRIMERS AND GUIDECOATS

ACTIVITY SHEET 1

Equipment:

Proper primer	Proper thinner or reducer	Paint paddles
Paint gun	Recommended respirator	Eye protection
Masked vehicle (car)		

Evaluation

3 2 1 N

- | | | | | |
|--|---|---|---|---|
| 1. Perform appropriate sanding and masking operations. | — | — | — | — |
| 2. Put on eye protection and respirator. | — | — | — | — |
| 3. Stir primer. | — | — | — | — |
| 4. Mix primer to recommended percentage. | — | — | — | — |
| 5. Adjust spray gun to correct pattern and pressure. | — | — | — | — |
| 6. Use correct spraying technique. | — | — | — | — |
| 7. Apply recommended number of coats. | — | — | — | — |
| 8. Allow appropriate drying time. | — | — | — | — |
| 9. Inspect surface for flaws. | — | — | — | — |
| 10. Sand places where needed. | — | — | — | — |

F. GUIDECOATS

A guidecoat is a primer of a different color than the main primer coat. You spray the guidecoat over the primer. Then you sand the car's body. After you've sanded the guidecoat, nicks and scratches show up as the same color as the primer.

1. Equipment:

Proper primer

Blow gun

Guidecoat (not primer color)

Strainer

Eye protection

Masked vehicle (car)

Recommended respirator

Proper thinner or reducer

Paint paddles

Paint gun

Sanding block

Proper sandpaper

2. Perform appropriate sanding and masking operations.

3. Put on eye protection and respirator.

4. Select and stir primer.



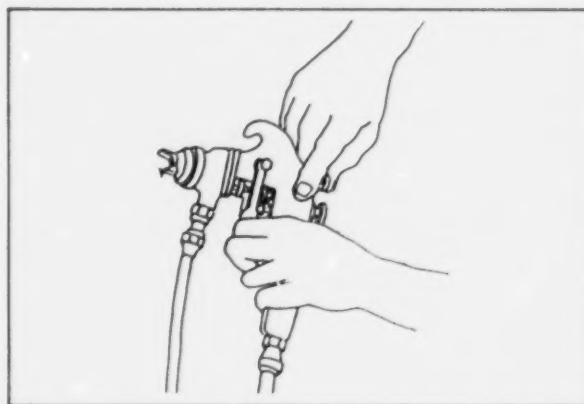
5. Mix primer with reducer or thinner to recommended percentage.

NOTE: Follow all label instructions and cautions.

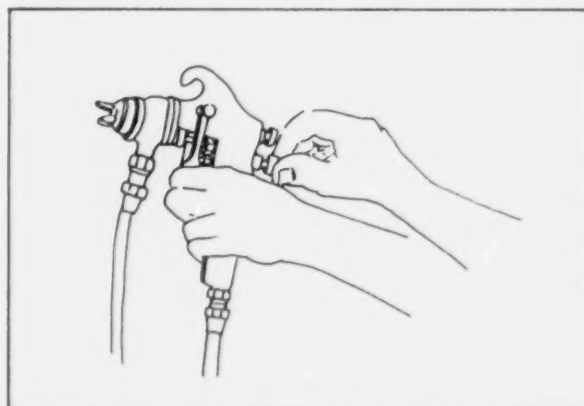
6. Strain mixed primer into spray gun cup.

7. Adjust spray gun to correct pattern.

8. Adjust gun to pressure recommended by primer manufacturer.



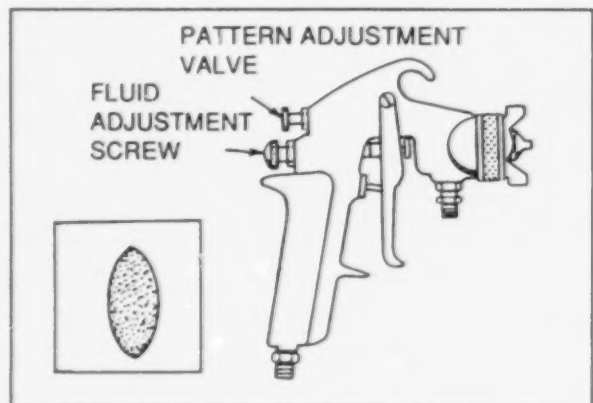
9. Use alternate right and left strokes. Release trigger at the beginning and end of each stroke.



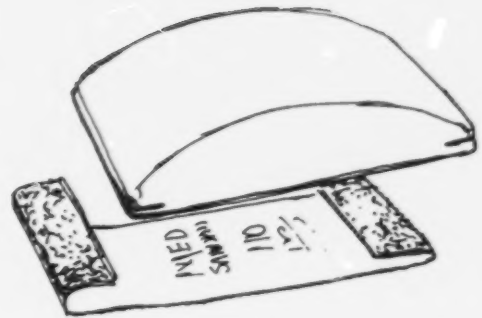
10. Apply recommended number of coats. Allow each coat to flash-off for the recommended length of time.

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11. Allow primer to dry for recommended length of time.
12. Sand and clean thoroughly.
13. Mix guidecoat with paddle.
14. Strain mixed guidecoat into spray gun cup.
15. Adjust spray gun to correct pattern.
16. Adjust gun to pressure recommended by manufacturer.
17. Spray guidecoat over entire panel.
18. Use alternate right and left strokes. Release trigger at the beginning and end of each stroke.



19. Allow guidecoat to flash-off for the recommended length of time.
20. Allow guidecoat to dry for the recommended length of time.
21. Use sanding block to lightly sand repair area. Use the recommended sandpaper.
22. Use the blow gun to clean area.
23. Wipe area with the cloth.



CAUTION: DO NOT check the area by running your hands over it. Oil from your fingers can ruin the paint job.

24. Reprime the surface.
25. Apply the guidecoat again.

DO SKILL SHEET 2
DO ACTIVITY SHEET 2

PRIMERS AND GUIDECOATS

SKILL SHEET 2

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- ___ 1. Guidecoats are used to detect nicks and scratches on the undercoating material.
- ___ 2. To check for nicks and scratches after sanding the guidecoat, you should run your hand over the area.
- ___ 3. More than one guide may be applied.
- ___ 4. Guidecoats are applied in up-and-down strokes.
- ___ 5. Guidecoats should not be strained.

PRIMERS AND GUIDECOATS

ACTIVITY SHEET 2

Equipment:

Proper primer	Proper thinner or reducer
Blow gun	Paint paddles
Guidecoat (not primer color)	Paint gun
Strainer	Sanding block
Eye protection	Proper sandpaper
Masked vehicle (car)	
Recommended respirator	

Procedure:

	<u>Evaluation</u>			
	3	2	1	N
1. Perform proper sanding and masking jobs.	—	—	—	—
2. Put on eye protection and respirator.	—	—	—	—
3. Select and stir primer with reducer according to manufacturer's directions.	—	—	—	—
4. Mix primer with reducer according to manufacturer's directions.	—	—	—	—
5. Strain primer into spray gun cup.	—	—	—	—
6. Adjust spray gun to correct pattern and pressure according to manufacturer's directions.	—	—	—	—

- | | | | | | |
|-----|--|---|---|---|---|
| 7. | Spray, using proper technique. | - | - | - | - |
| 8. | Apply recommended number of coats, allowing each coat to flash-off for recommended length of time. | - | - | - | - |
| 9. | Allow primer to dry for recommended length of time. | - | - | - | - |
| 10. | Sand and clean thoroughly. | - | - | - | - |
| 11. | Mix guidecoat properly. | - | - | - | - |
| 12. | Strain guidecoat into spray gun cup. | - | - | - | - |
| 13. | Adjust spray gun to pattern and air pressure recommended by manufacturer. | - | - | - | - |
| 14. | Spray guidecoat over panel, using correct technique. | - | - | - | - |
| 15. | Allow appropriate amount of time for flash-off. | - | - | - | - |
| 16. | Allow guidecoat to dry for recommended length of time. | - | - | - | - |
| 17. | Lightly sand with sanding block and proper sandpaper. | - | - | - | - |
| 18. | Clean area with blow gun. | - | - | - | - |
| 19. | Wipe area with tack cloth. | - | - | - | - |
| 20. | Reprime. | - | - | - | - |
| 21. | Apply guidecoat again, if necessary. | - | - | - | - |

PRIMERS AND GUIDECOATS

UNIT TEST

Directions: Match the following definitions with the correct terms.

- | | | |
|----------|--|--------------|
| _____ 1. | A layer of paint material, such as a primer, used to provide a smooth adhesive, a proper seal and a corrosion-free base for the color coat | A. Guidecoat |
| | | B. Undercoat |
| | | C. Bleeding |
| | | D. Reducer |
| | | E. Corrosion |
| _____ 2. | The color coat | F. Thinner |
| | | G. Topcoat |
| _____ 3. | The vehicle used with enamel | |
| _____ 4. | A process that occurs when a metal or other object is slowly eaten or worn away by rust or the action of chemicals | |
| _____ 5. | The act of a new color coat sinking through a primer material | |
| _____ 6. | The vehicle used with lacquer | |
| _____ 7. | A primer of a different color sprayed over a sanded primer. | |
| _____ 8. | A substance mixed with paint that helps the paint stick to the surface | |

____ 9. A chemically treated cloth used to remove dust from a car's surface just before painting.

____ 10. The initial stage of paint drying time during which some of the solvent in the paint evaporates.

____ 11. The act of sticking or attaching.

____ 12. Undercoating material used to promote adhesion and prevent corrosion.

____ 13. A substance, usually a liquid, that can dissolve another substance.

____ 14. The vehicle used with epoxy.

- A. Flash-off
- B. Tack rag
- C. Activator
- D. Vehicle
- E. Adhesion
- F. Primer
- G. Solvent

Directions: Identify the following tools.

15. _____



16. _____

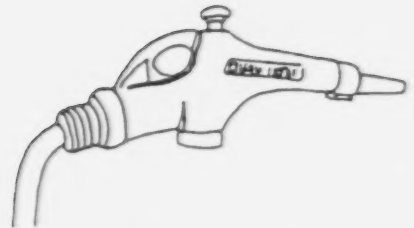
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17. _____



18. _____



19. _____



20. _____



Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 21. Epoxy primers may be used over plastic.
- _____ 22. The manufacturer's directions must be followed carefully during the refinishing process.
- _____ 23. Used tack rags should be placed in a plastic container as soon as the refinishing process is finished.
- _____ 24. A reciprocating sander should be used to sand primers.
- _____ 25. When wet sanding enamel primers, you should let the surface dry overnight.
- _____ 26. Primers never need to be sanded.
- _____ 27. Guidecoats are the same color as the primer.

Directions: Place the letter of the correct answer on the blank space.

- S 28. Primers are used to
- a. provide good adhesion
 - b. protect bare metal from rust.
 - c. make the topcoat last longer.
 - d. all of the above

- ____ 29. When using primers, you should
- a. wear safety glasses.
 - b. wear a respirator.
 - c. perform the task away from sparks.
 - d. all of the above
- ____ 30. Enamel primers are used with
- a. lacquer topcoats.
 - b. epoxy topcoats.
 - c. enamel topcoats.
 - d. all of the above
- ____ 31. Lacquer primers are used under
- a. lacquer topcoats.
 - b. plastic topcoats.
 - c. enamel topcoats.
 - d. lacquer and enamel topcoats.

PRIMERS AND GUIDECOATS

PERFORMANCE CHECKLIST

Student _____ successfully performed
the following tasks:

	Yes	No	Comments
1. Defined 14 words associated with primers and guidecoats			
2. Identified six tools associated with primers and guidecoats			
3. Followed auto body shop safety rules			
4. Applied a primer to the satisfaction of the instructor.			
5. Applied a guidecoat to the satisfaction of the instructor.			

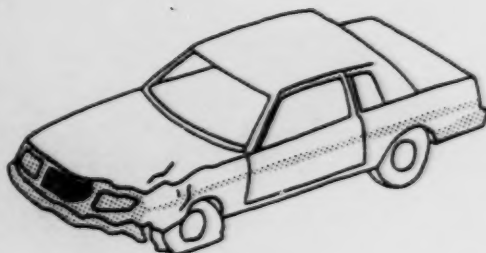
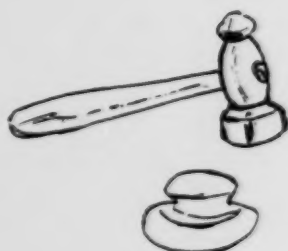
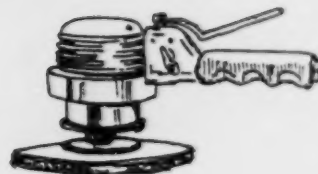
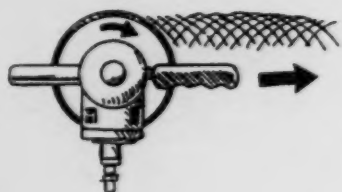
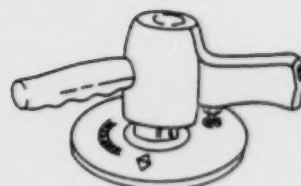
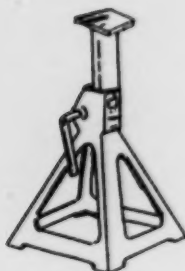
Satisfactory -- should move on _____

Should repeat this unit _____

Student's signature/Date

Instructor's signature/Date

MASKING



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

MASKING

INTRODUCTION

Masking a car before painting it requires skill and know-how. If you don't mask a vehicle correctly, you will waste time in refinishing a part that should not have gotten paint on it.

UNIT OBJECTIVE

After completing this unit, you should be able to mask a vehicle.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Define eight terms associated with the masking process.
2. Identify three pieces of equipment associated with the masking process.
3. Mask a panel for refinishing.
4. Remove masking material.

Put a check beside the statement that is true for you.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

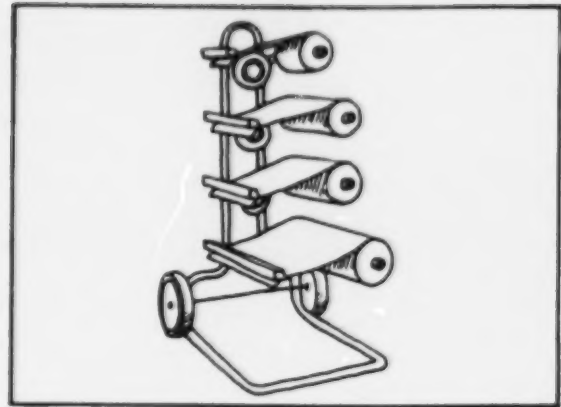
324

A. TERMS

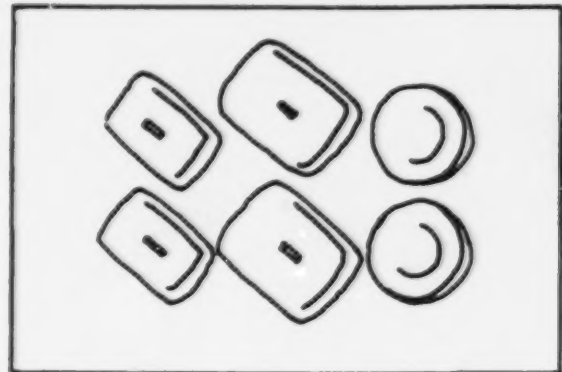
1. **Apron** - paper with masking tape at one edge; an apron is used to mask large areas against overspray.
2. **Bleed-through** - when paint is sprayed onto a surface and its overspray (see below) soaks through the masking material.
3. **Tape killing** - a process in which tape is run between the thumb and forefinger; tape killing is used on tape to prevent it from sticking to a newly painted surface.
4. **Masking** - the process of applying masking paper and/or tape to shield areas on a vehicle that are not to be painted.
5. **Masking paper** - a specially designed paper that prevents paint from bleeding through.
6. **Natural break** - a crown, a chrome strip or other definition line on a panel.
7. **Overspray** - an overlap of dry spray gun particles on areas that were not meant to be painted.
8. **Reverse taping** - a process in which paper is placed as if it were to cover the area to be painted, but then folded over the tape to form a roll at the tape line. Reverse taping is used to keep paint from bleeding through masked areas and to hold the paper away from the fresh top coat being masked.

B. EQUIPMENT

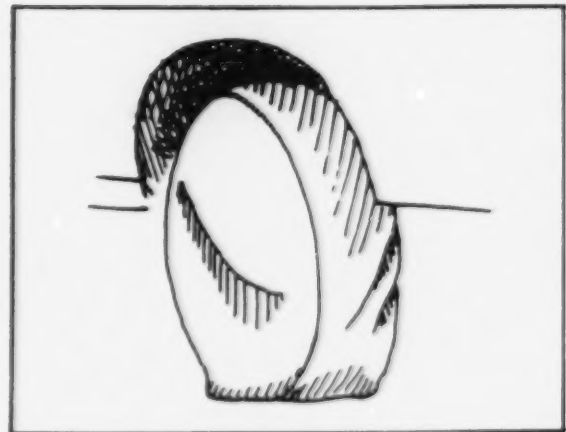
1. **Apron taper** - a masking paper dispenser that applies tape to the edge of paper as you pull it from the roll.



2. **Light covers** - plastic covers, available in different sizes and shapes, that mask the light assembly for painting. They save time and materials.



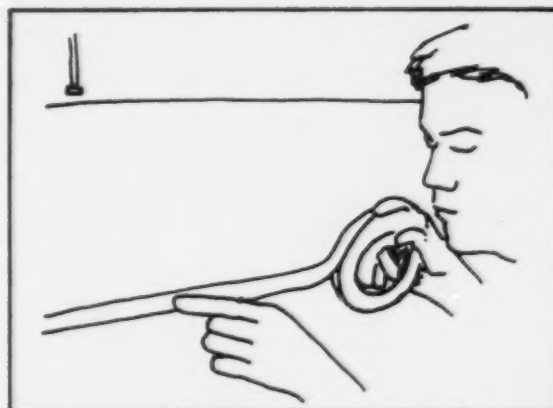
3. **Tire masks** - tire and wheel covers, available in stores. They protect the tires or wheels during the refinishing process. They save time and materials.



C. MASKING

You protect parts of the car that are not to be painted with masking tape and/or paper. You should use the widest material available that will do the job properly.

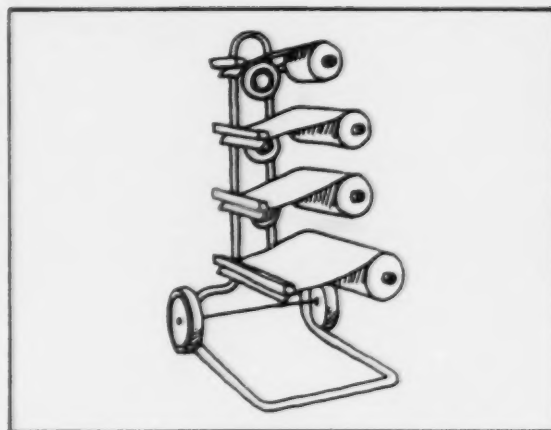
1. **Masking tape** (1) protects a surface from paint and (2) holds masking paper to a surface. Masking tape comes in widths from 1/8 to 3 inches. The most common tape is 3/4-inch.



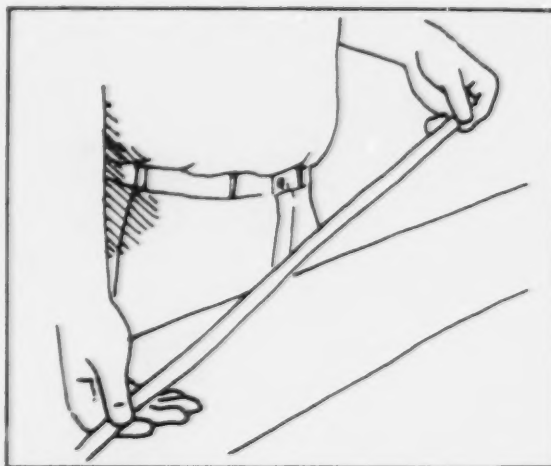
One type of masking tape, known as "striping tape," is designed especially for striping. It comes in pre-cut strips and in many different sizes. You apply the tape straight and mask the adjoining area with paper.

2. **Masking paper**, which is used to mask large areas, helps prevent "bleed-through." Be sure to use this special paper instead of other kinds. Masking paper comes in widths of 3, 6, 9, 12, 15, 18, 24 and 36 inches in rolls usually 1,000 feet long. The most common is 15 inches wide.

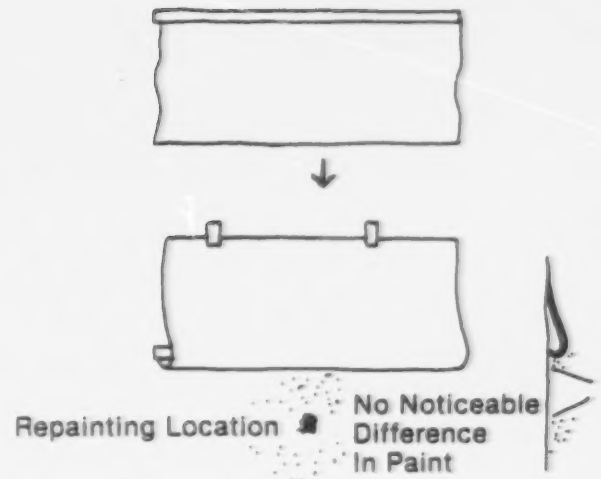
3. A **paper-taper** is often used to pre-tape the paper as you pull it out of this tool. The paper is cut by pulling upward against the cutting bar.



4. **Killing masking tape** Before you apply tape to a freshly-painted surface, "kill" it by running it between your thumb and forefinger. Killing the tape makes it less sticky, so it won't peel or lift fresh paint.



5. **Reverse taping** is a method used to blend the new and old finishes and to lessen the chance of bleed-through along the edge of the masked area. To do reverse taping, place the masking paper over the area to be painted. Tape it. Then, without removing the tape, fold the paper back over the area to be protected. Finally, tape the paper with small pieces to hold it back.



6. **Rules to remember:**

- Never apply tape to a dirty surface. It will not stick.
- Never apply tape to a damp or wet surface. It will not stick.
- Before you tape, the surface must be at least 60 degrees F.
- Store tape in a cool, dark area. Sunlight and heat can ruin it.

- Tape and paper should cover the surface to be painted completely.
- Do not use newspaper in place of masking paper.
- If you will be spraying a horizontal surface, use double masking, reverse taping or a high grade of paper to prevent bleed-through.
- When using a double layer of paper, the top piece must overlap the bottom piece.
- Tape and paper should not touch areas that are to be painted.

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D. MASKING PROCEDURE

1. Equipment:

Vehicle

Masking paper

Cleaning material

Clear lacquer

Small paint brush

Sharp knife or razor blade

Masking tape of different widths

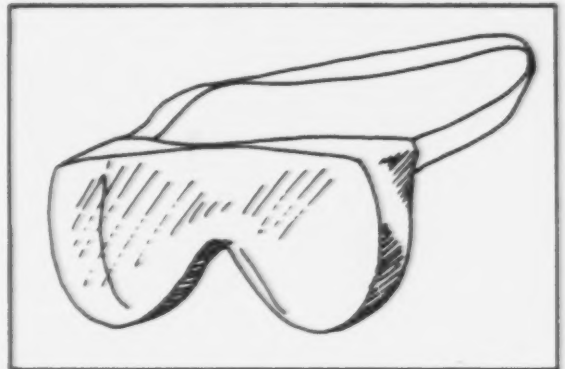
Blow gun

Hand tools

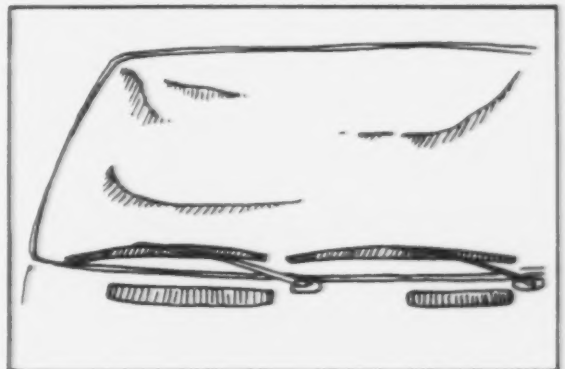
Clean, white rags or paper towels.

Eye protection

2. Put on eye protection.



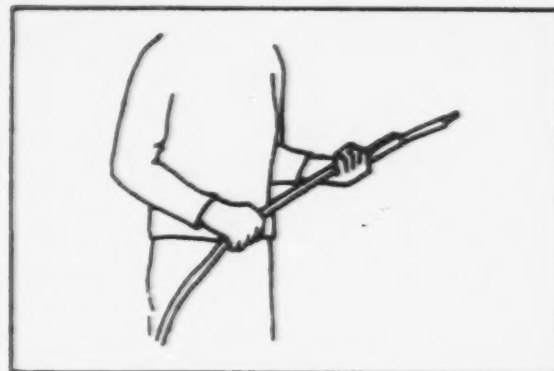
3. Remove trim, moldings and emblems that are safe to remove. Put them in a safe place. It is better to remove some trim, such as wiper blades, than to mask it. If you can't remove wiper blades, mask them with 3/4 inch tape in step seven.



4. Clean the surface with wax and grease remover. Wipe off the wax and grease remover.



5. Use the blow gun to dry around the moldings.

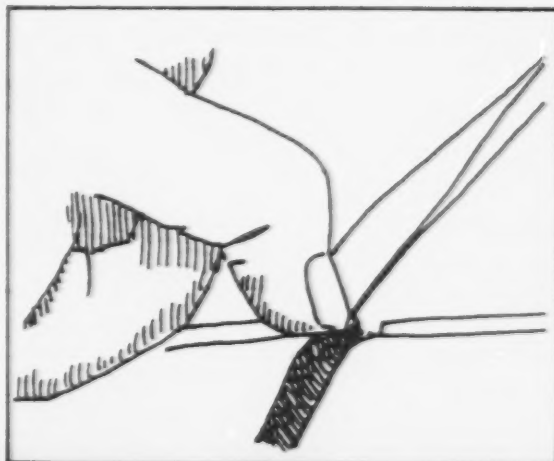


6. Mask small emblems or lettering with narrow tape, such as 1/4-inch. A narrow tape width bends easily and can be worked into small areas. Seal the edges tightly. Use a pocket knife to work the tape.



Unroll the tape. First apply the end of the tape firmly to the surface. As you unroll the tape a little at a time, stretch it and put it in place.

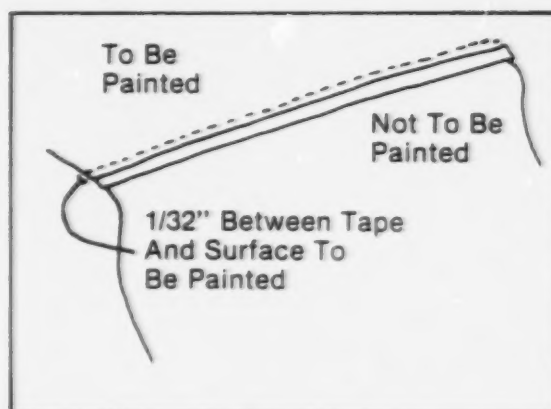
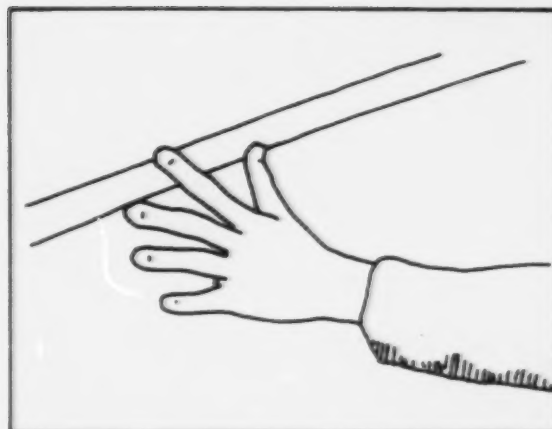
When you are done, tear the tape by pulling up on the roll and cutting the tape with your thumbnail.



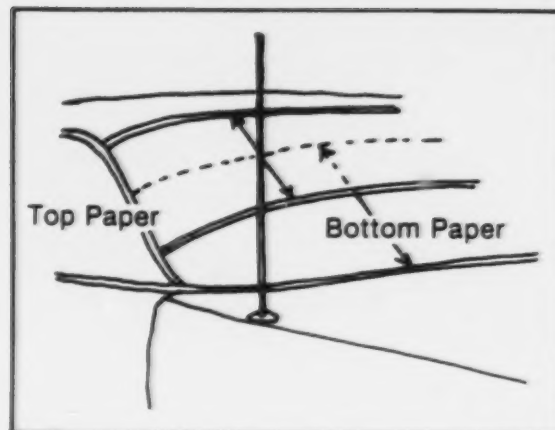
NOTE: Be careful not to stretch the tape too tightly, or it will shrink and leave bare areas. Be careful not to tangle the tape.

You must tape chrome and other moldings tightly. As you place a strip of tape over the entire edge where the paint and molding will join, do not lap over onto the surface to be painted. After you apply the tape, run your fingernail along the length of the tape to ensure a tight fit.

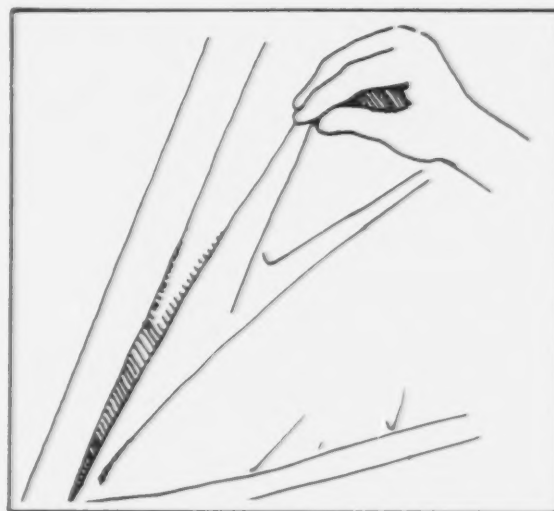
7. Use 3/4-inch tape to mask larger trim. For instance, you mask an antenna with a wider width of tape, first on one side and then the other. Then pinch the edges together.



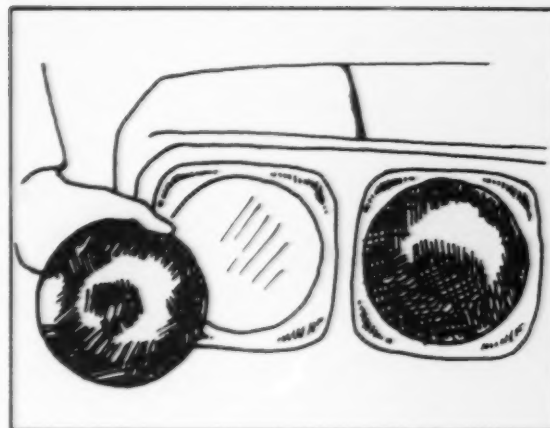
8. Use masking paper to mask large areas. Use two layers of paper when masking areas such as windshields or hoods. **Carefully overlap the bottom piece with the top piece.** Use reverse taping or two layers of tape and high grade paper when you mask for a urethane primer, which "bleeds" easily.



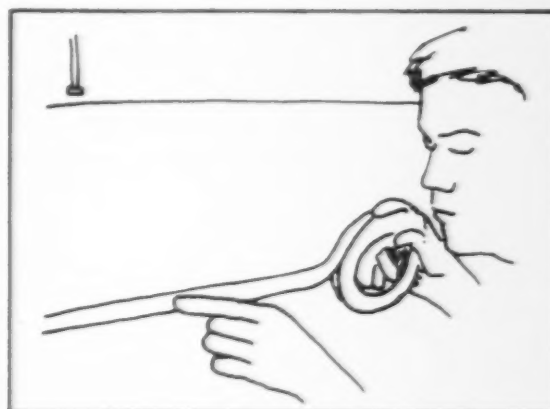
When masking angular areas, first find the longest straight line of the area. Tape the paper along this line. Fold the remaining paper to fit the rest of the area. Add more sections of paper if needed. Carefully tape all of the seams.



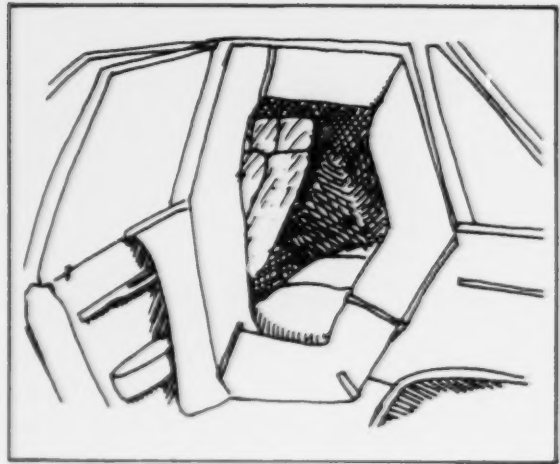
When masking large lights, narrow widths of paper (3 - 6 inches) usually work best because they bend easily. Cut, fold and work the paper before you apply the tape. You may want to use light covers and tire masks instead. They save time and material.



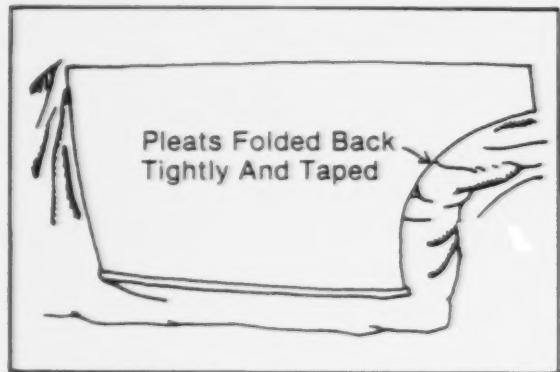
Mask panels along a natural break. This will help hide the spot where new paint ends and old paint begins. A natural break may occur at the top of a fender, at a sharp bend on the edge of a door or along a molding.



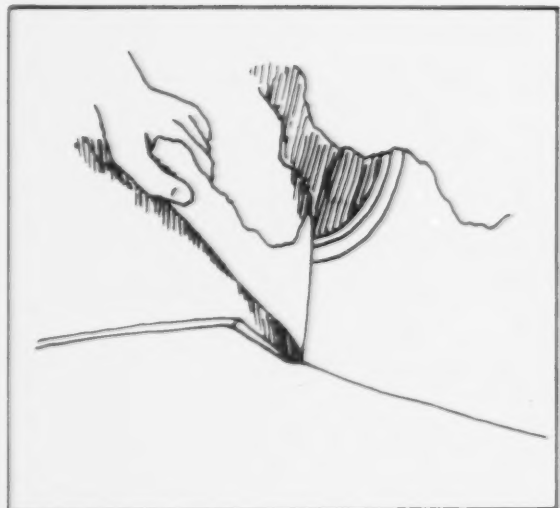
Mask door jambs to keep refinishing material from getting inside the vehicle. A 6-inch wide masking apron is usually enough. Because these areas are sprayed at close range, you don't need to mask the whole interior.



9. Trim excess tape with a razor blade or pocket knife. Fold back and tape extra paper securely. To prevent sanding dust from collecting, fold and tape any pleats in the paper.

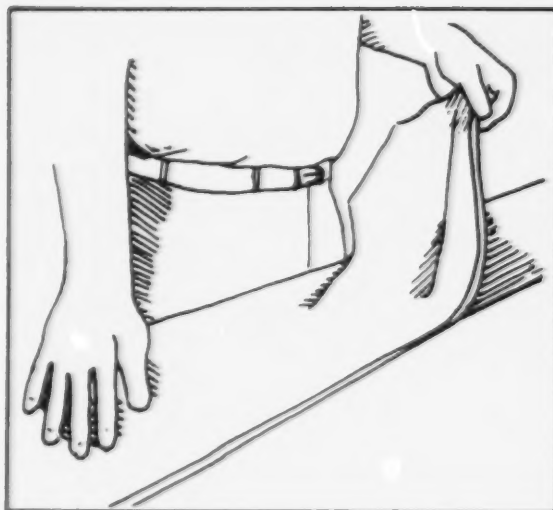


10. After the painting or refinishing is complete, you must carefully remove the masking material. If the masking is removed improperly, you can ruin the entire paint job. The time and method of removal are both important.



Always follow the paint or undercoating manufacturer's recommendations about drying time and masking removal. When panels or spot repairs are done, one person can remove the masking material. If the entire vehicle has been refinished, a helper may be needed.

When removing masking material, lift the paper in an almost vertical direction from the surface. **DO NOT** pull too fast. As you lift the masking material, watch for lifting of the top coat and for tears in the tape. When checking the paint for dryness, touch the masking material. **DO NOT** touch, and **DO NOT** let anything else touch, the vehicle's painted surface!



If the new finish is lacquer, remove the tape while the paint is still wet. If you leave masking material on too long, the paint will likely peel.

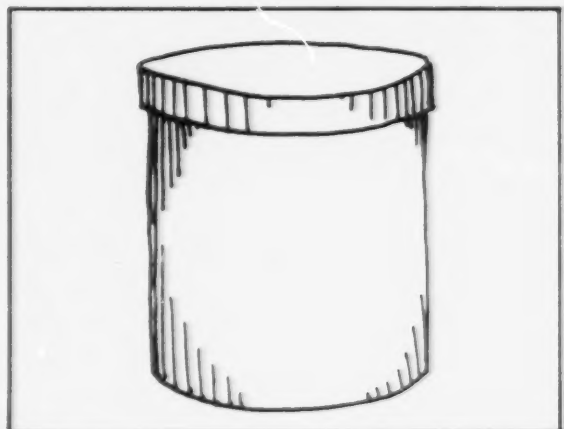
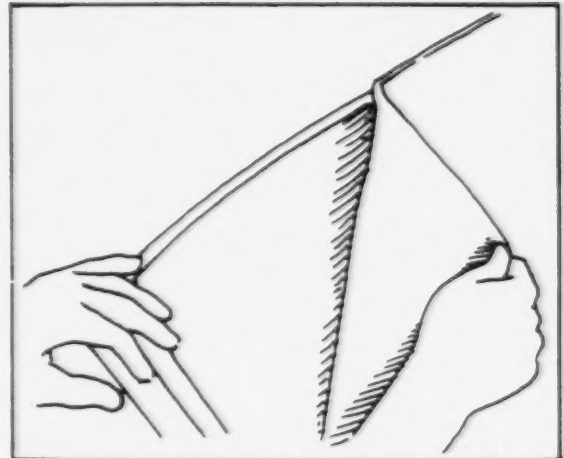
For an enamel finish, you don't need to remove the masking quickly. You can even wait until the next day.

If the finish is force dried or baked, remove the masking as soon as possible, pulling at an angle and using a cutting motion, which will cause a clean separation.

11. Place used masking material in a container with a lid. It is a fire hazard. Store tire and light covers for future use.

DO SKILL SHEETS 1 AND 2

DO ACTIVITY SHEETS 1 AND 2



MASKING
SKILL SHEET 1

Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 1. It is better to use several small sheets of masking paper than one large sheet.
- _____ 2. The most commonly used size of masking tape is 3/4-inch.
- _____ 3. It is best to unroll at least three feet of tape at a time.
- _____ 4. When applying tape, it is best to stretch it tightly, but not too tightly.
- _____ 5. An antenna should be wrapped with tape in a circular motion.
- _____ 6. Before you apply tape to a freshly painted surface, the tape should be "killed."
- _____ 7. Tape should not be applied to a wet surface.
- _____ 8. Before applying tape to a surface, the surface temperature should be at least 60 degrees F.
- _____ 9. Tape should be stored in a hot, sunny room.
- _____ 10. It is OK to use newspaper in place of masking paper.

- _____ 11. Two layers of paper should be used on windshields and hoods to prevent bleed-through.
- _____ 12. If masking for a urethane primer, two layers of high grade paper should be used.
- _____ 13. It is important to find the natural break when masking panels.
- _____ 14. Reverse taping is used to prevent bleed-through.
- _____ 15. It is best to double-mask areas when spraying a horizontal surface.
- _____ 16. Eye protection is not necessary when performing masking procedures.
- _____ 17. It is best to remove emblems if they can be removed.
- _____ 18. Light covers should never be used.
- _____ 19. Tires do not need to be masked or protected during refinishing procedures.
- _____ 20. Masking material is not a fire hazard.

MASKING
ACTIVITY SHEET 1

Equipment:

Vehicle

Masking tape of various widths

Masking paper

Cleaning materials

Clean, white rags or paper towels

Hand tools

Sharp knife or razor blade

Clear lacquer and small paintbrush

Proper eye protection

Procedure:

Evaluation

3 2 1 N

1. Put on eye protection and remove any trim that will not be masked.
2. Clean surfaces that will be masked and use blow gun to dry.
3. Use narrow masking tape to mask small emblems or lettering.
4. Use 3/4-inch tape to mask larger trim.
5. Use masking paper to mask large areas and openings.
7. Mask the panel along natural breaks.
8. Trim any excess tape.

—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

MASKING
SKILL SHEET 2

Directions: Circle the answer that best completes the sentences below.

1. Masking material on a lacquer finish should be removed
 - a. while the paint is still wet.
 - b. while the paint is tacky.
 - c. the day after the paint has been applied.
 - d. none of the above

2. Masking material on an enamel finish that has been force-dried should be removed
 - a. the next day.
 - b. immediately.
 - c. while the paint is tacky.
 - d. while the paint is still wet.

3. Masking material on an enamel finish that has air dried should be removed
 - a. the next day
 - b. immediately.
 - c. while the paint is tacky
 - d. while the paint is still wet.

4. Masking material on a baked or force dried finish should be removed with a
- a. quick jerk.
 - b. pair of scissors.
 - c. cutting motion.
 - d. all of the above
5. To determine when to remove the masking material, you should
- a. read the manufacturer's recommendations.
 - b. touch the masking material to feel the dryness of the paint.
 - c. ask your instructor.
 - d. all of the above

MASKING

ACTIVITY SHEET 2

Directions: Using panels prepared by your instructor, remove the masking material on a:

1. Panel that has been refinished with enamel.
2. Panel that has been refinished with lacquer.

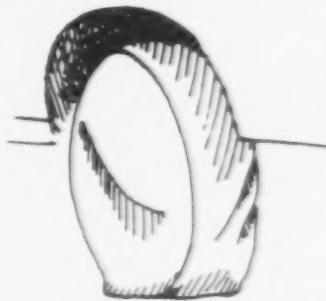
MASKING
UNIT TEST

Directions: Match the terms on the right with the definitions on the left.

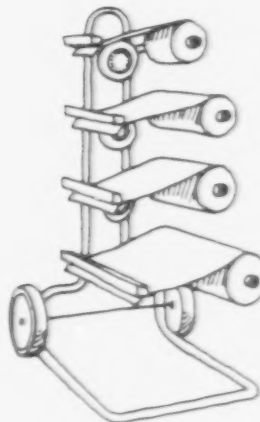
- | | | |
|----------|---|-------------------|
| _____ 1. | When dry spray gun particles overlap areas not meant to be sprayed | A. Bleed-through |
| _____ 2. | Paper with masking tape at one edge used to mask large areas against overspray | B. Apron |
| _____ 3. | When paint overspray soaks through masking material | C. Natural break |
| _____ 4. | A specially designed paper that prevents paint from bleeding through taping | D. Apron |
| _____ 5. | A crown, chrome strip or other definition line on a panel | E. Reverse taping |
| _____ 6. | A process used on tape to keep it from sticking to a newly painted surface | F. Overspray |
| _____ 7. | Applying masking paper and/or tape to shield areas on a vehicle that are not to be painted | G. Tape killing |
| _____ 8. | When paper is placed as if it were to cover the area to be painted, but then folded over the tape to form a roll at the tape line | H. Masking paper |

Directions: Identify the following pieces of equipment:

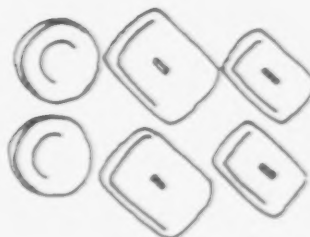
9. _____



10. _____



11. _____



Directions: Place a "T" in front of statements that are true. Place an "F" in front of statements that are false.

- _____ 12. The most commonly used size of masking tape is 1/2-inch.
- _____ 13. Before tape is applied to a freshly painted surface, the tape should be killed.
- _____ 14. You should not apply tape to a wet surface.

AUTO BODY
MASKING

- ____ 15. When you apply tape, the surface should be at least 80 degrees.
- ____ 16. Two layers of paper should be used on windshields to prevent bleed-through.
- ____ 17. If you are masking for a urethane primer, two layers of high grade paper should be used.
- ____ 18. It is important to find the natural break when masking panels.
- ____ 19. It is best to double-mask areas before spraying a horizontal surface.

Directions: Complete the sentences by using the words provided. Not all words will be used.

fifteen	cool	enamel	bleed-through
lacquer	trim	hot	molding

- 20. Tape should be stored in a _____ place.
- 21. Tape should not be stored in a _____ place.
- 22. The most commonly used width of paper is _____ inches.
- 23. An example of a natural break is a(n) _____.
- 24. Reverse taping is used to prevent _____.
- 25. Masking material is removed while the paint is still wet if a _____ finish has been applied.

MASKING
PERFORMANCE CHECKLIST

Student _____ successfully performed the
following tasks:

	YES	NO	COMMENTS
1. Defined eight terms associated with the masking process			
2. Identified three pieces of equipment associated with the masking process			
3. Masked a panel for refinishing			
4. Removed masking material			

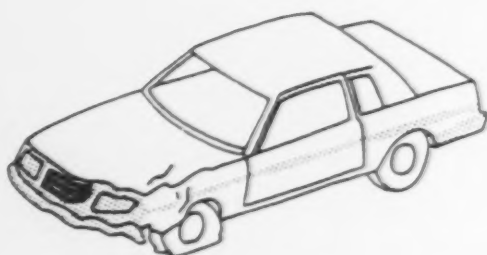
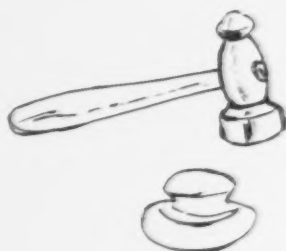
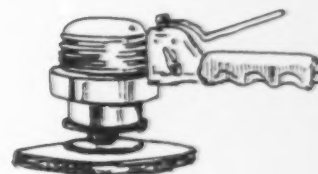
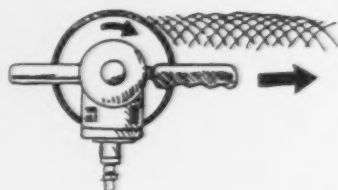
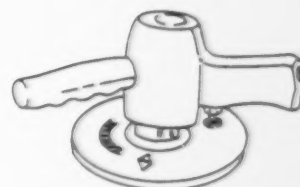
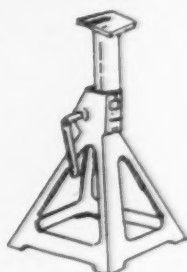
Satisfactory - should move on ☐

Should repeat this unit ☐

Student's Signature/Date

Instructor's Signature/Date

DIAGNOSING AND ANALYZING DAMAGE



Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

**DIAGNOSING AND ANALYZING DAMAGE
INTRODUCTION**

One of the most important jobs in a body shop is analyzing the damage and estimating the repair costs for a vehicle. If the business is to profit and keep its good reputation, repair estimates must be accurate, and repair prices must be reasonable.

UNIT OBJECTIVE

After completing this unit, you should be able to read estimates and "zone" a vehicle.

SPECIFIC OBJECTIVES

After completing this unit, you should be able to:

1. Define four terms that apply to estimating costs and analyzing damage.
2. Use the zone system, as recommended by I-CAR, to analyze damage.
3. Read a damage report.
4. Identify parts of a damage report.

Put a check beside the statement that is true for you.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

AUTO BODY

DIAGNOSING AND ANALYZING DAMAGE

A. TERMS

1. **Collision manual** - a book that lists specific repair jobs and the standard amount of labor time involved for them; it also lists the number, cost and location of parts. Collision manuals are also known as "crash manuals."
2. **Estimate** - a statement of what has been damaged and what it will cost to repair the damage. Estimates are sometimes called "damage reports."
3. **Inspector** - the person who checks out a vehicle (carries out an inspection).
4. **Primary (damage)** - damage that is the direct result of an impact.
5. **Secondary (damage)** - damage that results from the primary damage.

AUTO BODY DIAGNOSING AND ANALYZING DAMAGE

B. ESTIMATES

An estimate is a written list of the damage done to a vehicle and the costs of repairs. The estimate should be "itemized," which means each damaged part (item) and its repair cost is listed separately. Depending on the body shop, an estimate may or may not be done free of charge. The estimate should include information about:

1. Whether a part will be repaired or replaced
2. The labor time involved to fix the damage
3. The cost of the labor
4. General information (the owner's name, address and phone number, the name of the insurance agent and insurance company, the make and model of the vehicle)

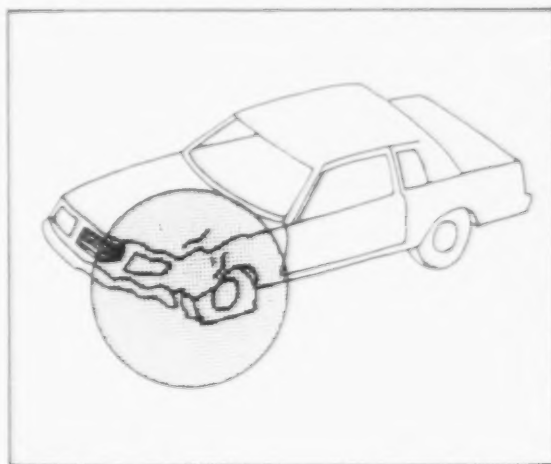
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<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DESCRIPTION</th> <th>QUANTITY</th> <th>UNIT PRICE</th> <th>TOTAL PRICE</th> </tr> </thead> <tbody> <tr> <td>1. <u>Front fender</u></td> <td>1</td> <td>150.00</td> <td>150.00</td> </tr> <tr> <td>2. <u>Door hinge</u></td> <td>2</td> <td>75.00</td> <td>150.00</td> </tr> <tr> <td>3. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>4. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>5. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>6. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>7. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>8. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>9. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>10. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>11. 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<td>147. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>148. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>149. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>150. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>151. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>152. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>153. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>154. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>155. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>156. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>157. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>158. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>159. <u>Paint</u></td> 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<td>100.00</td> </tr> <tr> <td>172. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>173. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>174. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>175. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>176. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>177. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>178. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>179. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>180. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>181. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>182. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>183. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>184. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>185. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>186. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>187. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>188. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>189. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>190. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>191. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>192. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>193. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>194. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>195. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>196. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>197. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>198. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>199. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>200. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>201. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>202. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>203. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>204. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>205. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>206. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>207. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>208. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>209. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>210. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>211. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>212. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>213. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>214. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>215. <u>Parts</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>216. <u>Paint</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>217. <u>Labor</u></td> <td>1</td> <td>100.00</td> <td>100.00</td> </tr> <tr> <td>2</td></tr></tbody></table>				DESCRIPTION	QUANTITY	UNIT PRICE	TOTAL PRICE	1. <u>Front fender</u>	1	150.00	150.00	2. <u>Door hinge</u>	2	75.00	150.00	3. <u>Paint</u>	1	100.00	100.00	4. <u>Labor</u>	1	100.00	100.00	5. <u>Parts</u>	1	100.00	100.00	6. <u>Paint</u>	1	100.00	100.00	7. <u>Labor</u>	1	100.00	100.00	8. <u>Parts</u>	1	100.00	100.00	9. <u>Paint</u>	1	100.00	100.00	10. <u>Labor</u>	1	100.00	100.00	11. <u>Parts</u>	1	100.00	100.00	12. <u>Paint</u>	1	100.00	100.00	13. <u>Labor</u>	1	100.00	100.00	14. <u>Parts</u>	1	100.00	100.00	15. <u>Paint</u>	1	100.00	100.00	16. <u>Labor</u>	1	100.00	100.00	17. <u>Parts</u>	1	100.00	100.00	18. <u>Paint</u>	1	100.00	100.00	19. <u>Labor</u>	1	100.00	100.00	20. <u>Parts</u>	1	100.00	100.00	21. <u>Paint</u>	1	100.00	100.00	22. <u>Labor</u>	1	100.00	100.00	23. <u>Parts</u>	1	100.00	100.00	24. <u>Paint</u>	1	100.00	100.00	25. <u>Labor</u>	1	100.00	100.00	26. <u>Parts</u>	1	100.00	100.00	27. <u>Paint</u>	1	100.00	100.00	28. <u>Labor</u>	1	100.00	100.00	29. <u>Parts</u>	1	100.00	100.00	30. <u>Paint</u>	1	100.00	100.00	31. <u>Labor</u>	1	100.00	100.00	32. <u>Parts</u>	1	100.00	100.00	33. <u>Paint</u>	1	100.00	100.00	34. <u>Labor</u>	1	100.00	100.00	35. <u>Parts</u>	1	100.00	100.00	36. <u>Paint</u>	1	100.00	100.00	37. <u>Labor</u>	1	100.00	100.00	38. <u>Parts</u>	1	100.00	100.00	39. <u>Paint</u>	1	100.00	100.00	40. <u>Labor</u>	1	100.00	100.00	41. <u>Parts</u>	1	100.00	100.00	42. <u>Paint</u>	1	100.00	100.00	43. <u>Labor</u>	1	100.00	100.00	44. <u>Parts</u>	1	100.00	100.00	45. <u>Paint</u>	1	100.00	100.00	46. <u>Labor</u>	1	100.00	100.00	47. <u>Parts</u>	1	100.00	100.00	48. <u>Paint</u>	1	100.00	100.00	49. <u>Labor</u>	1	100.00	100.00	50. <u>Parts</u>	1	100.00	100.00	51. <u>Paint</u>	1	100.00	100.00	52. <u>Labor</u>	1	100.00	100.00	53. <u>Parts</u>	1	100.00	100.00	54. <u>Paint</u>	1	100.00	100.00	55. <u>Labor</u>	1	100.00	100.00	56. <u>Parts</u>	1	100.00	100.00	57. <u>Paint</u>	1	100.00	100.00	58. <u>Labor</u>	1	100.00	100.00	59. <u>Parts</u>	1	100.00	100.00	60. <u>Paint</u>	1	100.00	100.00	61. <u>Labor</u>	1	100.00	100.00	62. <u>Parts</u>	1	100.00	100.00	63. <u>Paint</u>	1	100.00	100.00	64. <u>Labor</u>	1	100.00	100.00	65. <u>Parts</u>	1	100.00	100.00	66. <u>Paint</u>	1	100.00	100.00	67. <u>Labor</u>	1	100.00	100.00	68. <u>Parts</u>	1	100.00	100.00	69. <u>Paint</u>	1	100.00	100.00	70. <u>Labor</u>	1	100.00	100.00	71. <u>Parts</u>	1	100.00	100.00	72. <u>Paint</u>	1	100.00	100.00	73. <u>Labor</u>	1	100.00	100.00	74. <u>Parts</u>	1	100.00	100.00	75. <u>Paint</u>	1	100.00	100.00	76. <u>Labor</u>	1	100.00	100.00	77. <u>Parts</u>	1	100.00	100.00	78. <u>Paint</u>	1	100.00	100.00	79. <u>Labor</u>	1	100.00	100.00	80. <u>Parts</u>	1	100.00	100.00	81. <u>Paint</u>	1	100.00	100.00	82. <u>Labor</u>	1	100.00	100.00	83. <u>Parts</u>	1	100.00	100.00	84. <u>Paint</u>	1	100.00	100.00	85. <u>Labor</u>	1	100.00	100.00	86. <u>Parts</u>	1	100.00	100.00	87. <u>Paint</u>	1	100.00	100.00	88. <u>Labor</u>	1	100.00	100.00	89. <u>Parts</u>	1	100.00	100.00	90. <u>Paint</u>	1	100.00	100.00	91. <u>Labor</u>	1	100.00	100.00	92. <u>Parts</u>	1	100.00	100.00	93. <u>Paint</u>	1	100.00	100.00	94. <u>Labor</u>	1	100.00	100.00	95. <u>Parts</u>	1	100.00	100.00	96. <u>Paint</u>	1	100.00	100.00	97. <u>Labor</u>	1	100.00	100.00	98. <u>Parts</u>	1	100.00	100.00	99. <u>Paint</u>	1	100.00	100.00	100. <u>Labor</u>	1	100.00	100.00	101. <u>Parts</u>	1	100.00	100.00	102. <u>Paint</u>	1	100.00	100.00	103. <u>Labor</u>	1	100.00	100.00	104. <u>Parts</u>	1	100.00	100.00	105. <u>Paint</u>	1	100.00	100.00	106. <u>Labor</u>	1	100.00	100.00	107. <u>Parts</u>	1	100.00	100.00	108. <u>Paint</u>	1	100.00	100.00	109. <u>Labor</u>	1	100.00	100.00	110. <u>Parts</u>	1	100.00	100.00	111. <u>Paint</u>	1	100.00	100.00	112. <u>Labor</u>	1	100.00	100.00	113. <u>Parts</u>	1	100.00	100.00	114. <u>Paint</u>	1	100.00	100.00	115. <u>Labor</u>	1	100.00	100.00	116. <u>Parts</u>	1	100.00	100.00	117. <u>Paint</u>	1	100.00	100.00	118. <u>Labor</u>	1	100.00	100.00	119. <u>Parts</u>	1	100.00	100.00	120. <u>Paint</u>	1	100.00	100.00	121. <u>Labor</u>	1	100.00	100.00	122. <u>Parts</u>	1	100.00	100.00	123. <u>Paint</u>	1	100.00	100.00	124. <u>Labor</u>	1	100.00	100.00	125. <u>Parts</u>	1	100.00	100.00	126. <u>Paint</u>	1	100.00	100.00	127. <u>Labor</u>	1	100.00	100.00	128. <u>Parts</u>	1	100.00	100.00	129. <u>Paint</u>	1	100.00	100.00	130. <u>Labor</u>	1	100.00	100.00	131. <u>Parts</u>	1	100.00	100.00	132. <u>Paint</u>	1	100.00	100.00	133. <u>Labor</u>	1	100.00	100.00	134. <u>Parts</u>	1	100.00	100.00	135. <u>Paint</u>	1	100.00	100.00	136. <u>Labor</u>	1	100.00	100.00	137. <u>Parts</u>	1	100.00	100.00	138. <u>Paint</u>	1	100.00	100.00	139. <u>Labor</u>	1	100.00	100.00	140. <u>Parts</u>	1	100.00	100.00	141. <u>Paint</u>	1	100.00	100.00	142. <u>Labor</u>	1	100.00	100.00	143. <u>Parts</u>	1	100.00	100.00	144. <u>Paint</u>	1	100.00	100.00	145. <u>Labor</u>	1	100.00	100.00	146. <u>Parts</u>	1	100.00	100.00	147. <u>Paint</u>	1	100.00	100.00	148. <u>Labor</u>	1	100.00	100.00	149. <u>Parts</u>	1	100.00	100.00	150. <u>Paint</u>	1	100.00	100.00	151. <u>Labor</u>	1	100.00	100.00	152. <u>Parts</u>	1	100.00	100.00	153. <u>Paint</u>	1	100.00	100.00	154. <u>Labor</u>	1	100.00	100.00	155. <u>Parts</u>	1	100.00	100.00	156. <u>Paint</u>	1	100.00	100.00	157. <u>Labor</u>	1	100.00	100.00	158. <u>Parts</u>	1	100.00	100.00	159. <u>Paint</u>	1	100.00	100.00	160. <u>Labor</u>	1	100.00	100.00	161. <u>Parts</u>	1	100.00	100.00	162. <u>Paint</u>	1	100.00	100.00	163. <u>Labor</u>	1	100.00	100.00	164. <u>Parts</u>	1	100.00	100.00	165. <u>Paint</u>	1	100.00	100.00	166. <u>Labor</u>	1	100.00	100.00	167. <u>Parts</u>	1	100.00	100.00	168. <u>Paint</u>	1	100.00	100.00	169. <u>Labor</u>	1	100.00	100.00	170. <u>Parts</u>	1	100.00	100.00	171. <u>Paint</u>	1	100.00	100.00	172. <u>Labor</u>	1	100.00	100.00	173. <u>Parts</u>	1	100.00	100.00	174. <u>Paint</u>	1	100.00	100.00	175. <u>Labor</u>	1	100.00	100.00	176. <u>Parts</u>	1	100.00	100.00	177. <u>Paint</u>	1	100.00	100.00	178. <u>Labor</u>	1	100.00	100.00	179. <u>Parts</u>	1	100.00	100.00	180. <u>Paint</u>	1	100.00	100.00	181. <u>Labor</u>	1	100.00	100.00	182. <u>Parts</u>	1	100.00	100.00	183. <u>Paint</u>	1	100.00	100.00	184. <u>Labor</u>	1	100.00	100.00	185. <u>Parts</u>	1	100.00	100.00	186. <u>Paint</u>	1	100.00	100.00	187. <u>Labor</u>	1	100.00	100.00	188. <u>Parts</u>	1	100.00	100.00	189. <u>Paint</u>	1	100.00	100.00	190. <u>Labor</u>	1	100.00	100.00	191. <u>Parts</u>	1	100.00	100.00	192. <u>Paint</u>	1	100.00	100.00	193. <u>Labor</u>	1	100.00	100.00	194. <u>Parts</u>	1	100.00	100.00	195. <u>Paint</u>	1	100.00	100.00	196. <u>Labor</u>	1	100.00	100.00	197. <u>Parts</u>	1	100.00	100.00	198. <u>Paint</u>	1	100.00	100.00	199. <u>Labor</u>	1	100.00	100.00	200. <u>Parts</u>	1	100.00	100.00	201. <u>Paint</u>	1	100.00	100.00	202. <u>Labor</u>	1	100.00	100.00	203. <u>Parts</u>	1	100.00	100.00	204. <u>Paint</u>	1	100.00	100.00	205. <u>Labor</u>	1	100.00	100.00	206. <u>Parts</u>	1	100.00	100.00	207. <u>Paint</u>	1	100.00	100.00	208. <u>Labor</u>	1	100.00	100.00	209. <u>Parts</u>	1	100.00	100.00	210. <u>Paint</u>	1	100.00	100.00	211. <u>Labor</u>	1	100.00	100.00	212. <u>Parts</u>	1	100.00	100.00	213. <u>Paint</u>	1	100.00	100.00	214. <u>Labor</u>	1	100.00	100.00	215. <u>Parts</u>	1	100.00	100.00	216. <u>Paint</u>	1	100.00	100.00	217. <u>Labor</u>	1	100.00	100.00	2
DESCRIPTION	QUANTITY	UNIT PRICE	TOTAL PRICE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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C. INSPECTION USING THE ZONE SYSTEM

A "zone" system is a good way to analyze damage. In a zone system, the vehicle is divided into five zones. The person doing the estimate checks each zone, (1) lists the damaged items on a checksheet, (2) notes whether the items must be repaired or replaced and (3) notes what refinishing procedures are needed.



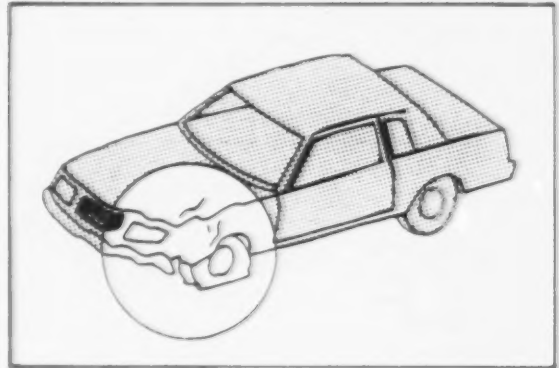
1. **Zone 1.** Areas of **primary damage** belong in Zone 1. Primary damage is directly caused by the impact of the collision. It is often the most visible damage. Areas of primary damage lie at the point of contact with what the vehicle hit. It usually involves panels and other major components.



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2. **Zone 2.** Areas of **secondary damage** belong in Zone 2. Secondary damage is caused by primary damage. The inspector often must look closely to find it. The inspection may involve panels and other major components in all areas outside the primary damage area (Zone 1). To find secondary damage, the inspector operates anything that should open, close, turn or move in any way. On hood, door and deck openings, the inspector should check the opening gap size.

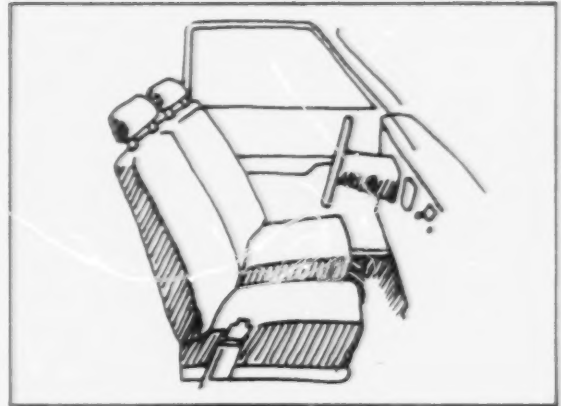


3. **Zone 3.** **Mechanical components** make up Zone 3. They include the engine, drive train and suspension. If possible, the inspector should check Zone 3

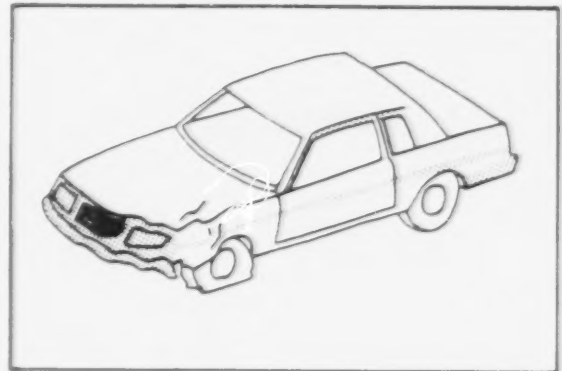


by starting the engine and operating the power train.

4. **Zone 4** is for the **passenger compartment**. The inspector should check damage to interior components closely.



5. **Zone 5** deals with **exterior trim**, which includes moldings and bumper assemblies.



D. DAMAGE ANALYSIS

It is important to have a standard damage analysis system, such as the one that follows. If you don't look at each vehicle in the same way, you might accidentally overlook some damage.

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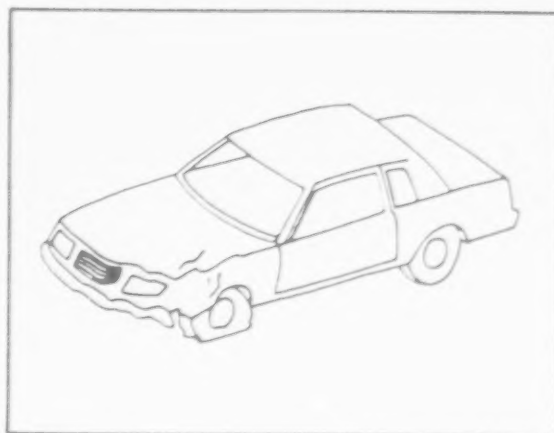
Some parts will be listed in more

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than one zone. Write the parts down when you first see them. Don't worry about whether a borderline item would fall under primary or secondary damage. Just make sure to record it. Otherwise, the estimate will not be accurate.

1. Record the major cosmetic panels in the primary damage area that must be repaired or replaced. These panels are called outer panels or "skin."



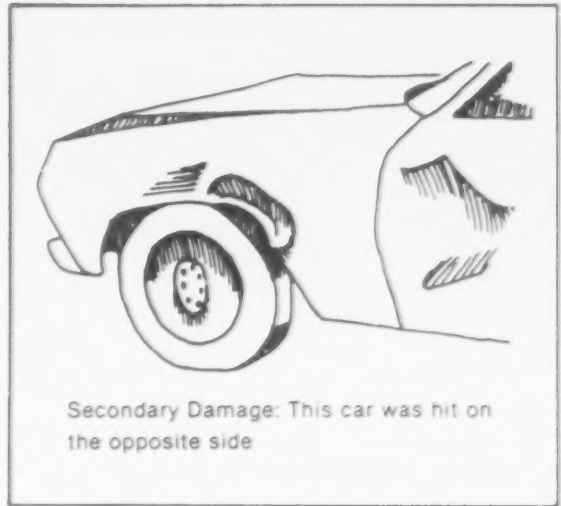
NOTE: Be careful not to cause more damage to the vehicle when checking it.

As you check the vehicle, remember to look for (1) broken welds, (2) paint stress, (3) damaged seam sealer, (4) damaged

AUTO BODY

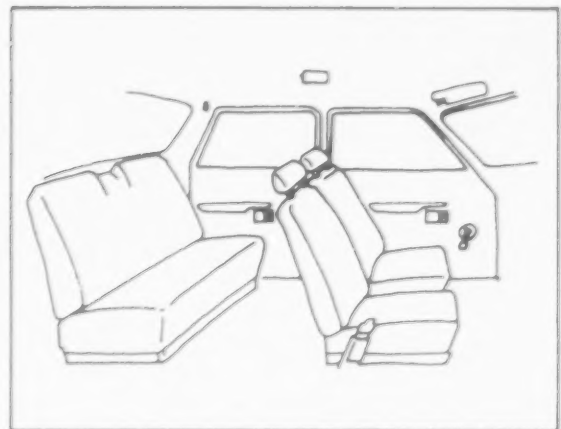
DIAGNOSING AND ANALYZING DAMAGE

6. Record structural panels with secondary damage.



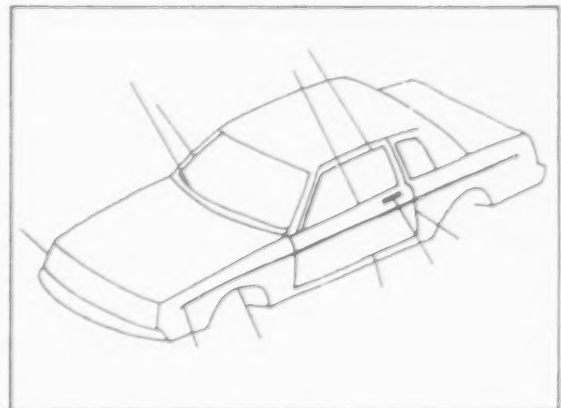
7. Record other damaged components.

8. Record damaged mechanical components, such as the engine, drive shaft and steering.



9. Record damaged passenger compartment components, such as the seats and dash board.

10. Record damaged trim components.

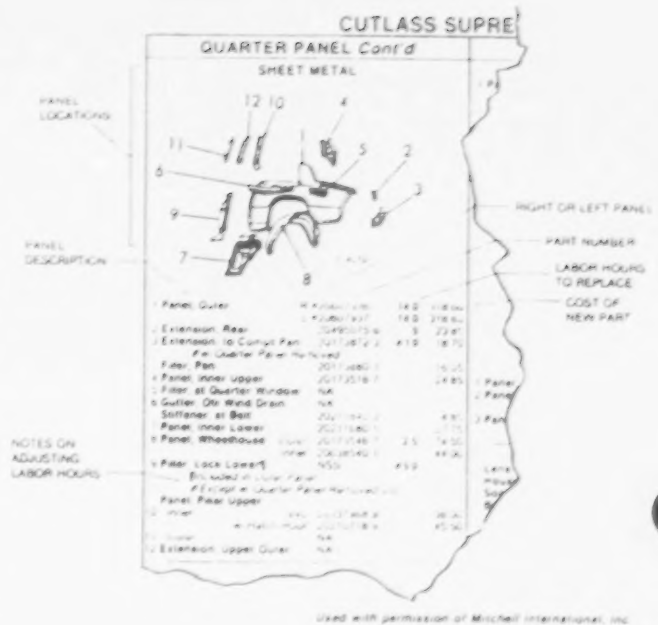


11. After you gather the information, use the front-to-back procedure in the collision, or

"crash," manual and write the "damage report" or "estimate." If the shop charges a fee, the estimate is usually called a "damage report." The collision manual gives the (1) location and (2) description of panels, (3) parts numbers, (4) number of hours it takes to do the repair and (5) cost of a new part.

NOTE: To make sure part prices are current, use the latest edition of the collision manual.

The collision manual lists makes of cars in alphabetical order. For example, under Ford cars, Crown Victoria comes first, Escort second, etc. The manual describes parts of the vehicle from front to rear or from front bumper to back bumper.



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Based on skill and experience, the estimator decides which parts are to be repaired or replaced. He or she records the decision on the form.



If the cost of a part is not known, the estimator should call for a price check.



If the estimator thinks that a part may be damaged but cannot be sure until the car is taken apart, the part is included in the damage report and "left open" is written in the place of parts and labor prices. This tells the customer and insurance company the shop will not know the cost for these parts until the car has been taken apart and checked.

If part of the work is to be done by a subcontractor, the subcontractor is asked to submit a price, which is included in the estimate.

The labor hours given in the collision manual for each job are estimates. Adjust the estimate if the job will take more time because of severe damage. For example, if severely damaged sheet metal must be cut away, add more time.

Labor is figured at the body shop's rate. If a shop charges \$10 per hour and it takes 14 hours to replace the right outer panel, the cost in labor will be \$140.



$$\text{\$10 per hour} \times 14 \text{ hours} = \text{\$140}$$

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E. DAMAGE REPORT

An example of a completed damage report (estimate) is on page 16. The numbered comments on the pages that follow refer to entries on the damage report.

On page 20, part of a page from a collision manual is shown. The parts indicated in the collision manual example are those entered on the damage report form.

DIAGNOSING AND ANALYZING DAMAGE

1. Name and address of the body shop.
2. Page number. Sometimes there will be more than one page of repairs listed.
3. Owner's name.
4. Date the damage report was made.
5. Address of the vehicle's owner.
6. Phone number of the vehicle's owner.
7. Name of the vehicle owner's insurance company.
8. The insurance adjuster's name.
9. The insurance adjuster's phone number.
10. Year and model of the vehicle.
11. Model and make of the vehicle.
12. License plate number.
13. "VIN" stands for "Vehicle Identification Number." The VIN is located on a small metal plate where the dashboard and windshield meet. It can be seen by standing outside the car and looking in through the windshield from the front.
14. The number of miles on the odometer.
15. If the part is to be repaired, this box is checked.
16. If a new part is needed, this box is checked.

17. The name of the part is listed and described here. The estimator should describe right, left, chrome, painted, etc. on this line. This information can be found in the collision manual.
18. The amount of time needed to repair or replace the part is shown in this space. If the part is to be replaced, the collision manual tells the estimator what to write here. If the part is to be repaired, the estimator must depend on experience to complete this amount.
19. The part number, which is found in the collision manual, is written here.
20. The cost of the new part, which is found in the collision manual, goes here.
21. The cost of the labor is entered here. The hourly rate charged by the shop is multiplied by the labor hours entered in number (18) above.
22. If refinishing is needed, the estimator writes it on a blank line at the end of the report. Specific parts may or may not be listed. The total time for the refinishing work is listed under "labor hours." An estimate of the cost of the materials that will be needed for the refinishing work (primer, paint, etc.) is put under the amount column (20). The cost of the labor is listed in column (21).
23. Most insurance policies require the owner of the vehicle to pay a deductible, which varies with the insurance policy the owner owns. For

DIAGNOSING AND ANALYZING DAMAGE

instance, if the owner's insurance policy has a \$200 deductible, the owner has to pay the first \$200 of damage repair. In this case, \$200 is entered here.

24. After the owner pays the deductible, the insurance company pays the rest of the bill. If a policy owner has a \$200 deductible and the bill is \$500, the insurance company will pay \$300. ($\$500 - \$200 = \$300$)
25. The costs of all new parts and refinishing materials are added together and placed in this space.
26. The cost of all repair and refinishing time is added together and entered here.
27. If the vehicle was towed to the shop, the towing fee is entered in this space.
28. The tax rate, which varies from town to town, and the tax amount are entered here. Parts are taxable, but labor is not. If the tax rate were 5 percent, the parts total (25) would be multiplied by 5 percent.
29. The cost for materials and tax are added together (spaces 25 and 28), and the total is placed here.
30. To get the Grand Total, add the totals for labor, towing, and parts and taxes (spaces 27, 28 and 30). Place the total here.
31. The owner of the vehicle signs the estimate in this space. The signature means he or she is allowing the shop to make the repairs listed.

- [illegible]

DO ACTIVITY SHEETS 1 AND 2

DIAGNOSING AND ANALYZING DAMAGE DIAGNOSING AND ANALYZING DAMAGE

SKILL SHEET 1

Directions: Tell which zone is being described by putting number 1, 2, 3, 4 or 5 in the blanks below.

Zone #

1. _____ Secondary damage
2. _____ Passenger compartment
3. _____ Primary damage
4. _____ Exterior trim
5. _____ Mechanical components

Directions: Place a "T" in front of the statements that are true. Place an "F" in front of the statements that are false.

- _____ 6. A tolerance of 3 mm is allowed for unibody vehicles.
- _____ 7. Body shops always provide damage reports free.

- _____ 8. Secondary damage is caused by primary damage.
- _____ 9. Refinishing costs are not figured when making an estimate.
- _____ 10. A damage analysis system helps to keep the inspector from overlooking damage.
- _____ 11. The engine of a damaged vehicle should not be started.
- _____ 12. Welds should be closely examined.
- _____ 13. An estimate lists each item to be repaired or replaced.
- _____ 14. Opening gap sizes should be checked.
- _____ 15. Panels and other major components are usually involved in primary damage.

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DIAGNOSING AND ANALYZING DAMAGE

DIAGNOSING AND ANALYZING DAMAGE

ACTIVITY SHEET 1

Directions: Using a zone system, analyze the damage to a vehicle provided by your instructor.

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DIAGNOSING AND ANALYZING DAMAGE

SKILL SHEET 2

Directions: Using the estimate on the previous page, answer the following questions. Write your answers on a separate sheet of paper.

1. How many parts will be repaired?
2. How many parts will be replaced?
3. How much time is needed to replace the hinge?
4. What is the cost of a latch?
5. Who owns the car?
6. What is the cost of refinishing material?
7. What is the part number for the weatherstrip?
8. What is the tax rate?

9. What is the total of material and tax?
10. Who is the insurance agent?
11. What kind of vehicle is being repaired?
12. Was there a towing charge?
13. What is the total cost of the estimate?
14. What is the cost of labor for the latch?
15. Did the insurance adjuster sign the estimate on the same day the estimate was made?

ACTIVITY SHEET 2

1. Parts numbers for the needed parts:
2. Cost of parts:
3. Amount of time needed to replace the parts:

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Used with permission of Mitchell International, Inc.

DIAGNOSING AND ANALYZING DAMAGE

DIAGNOSING AND ANALYZING DAMAGE

UNIT TEST

Directions: Match the definition on the left with the term on the right.

- | | | |
|----------|--|---------------------|
| _____ 1. | A book that lists repair jobs and how much time they take, as well as the numbers, cost and location of parts. | A. Estimate |
| _____ 2. | A statement of what has been damaged and what it will cost to repair the damage. | B. Collision manual |
| _____ 3. | Damage caused by primary damage. | C. Secondary damage |
| _____ 4. | Damage directly caused by impact. | D. Primary damage |

Directions: Place a "T" in front of the statements that are true. Place an "F" in front of the statements that are false.

- _____ 5. A written estimate should be done in a sequence that follows the format of a collision manual.
- _____ 6. It is a good idea to use a zone system to analyze damage.

7. "Left open" on an estimate means the price of the parts and labor cannot be known until a more thorough inspection is done.

8. "Damage report" and "estimate" are two names for the same thing.

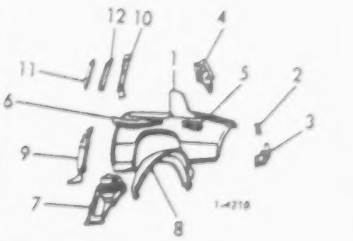
Directions: Using the portion of the collision manual on the next page, fill in the blanks.

9. The upper inside garnish molding of a four-door Cutlass costs _____.

10. It takes _____ hours to replace the outer wheelhouse panel.

11. The part number for the outer wheelhouse panel is _____.

BACK WINDOW				
Glass, Back Window				
2 Door	Clear	20358210	01.5	120.00
	NAGS	C 95741	01.5	137.85
	Tinted	20358211	01.5	142.00
	NAGS	T 85741	01.5	140.05
4 Door Sedan	Heated	20358212	01.7	280.00
	NAGS	T 85740	01.7	278.40
	Clear	20146808	01.5	133.00
	NAGS	C 96129	01.5	135.00
	Tinted	20146809	01.5	137.00
	NAGS	T 86129	01.5	136.50
	Heated	20146810	01.7	284.00
	NAGS	T 86128	01.7	280.50
# w/ Tucked Vinyl Top Add 3.5				
Moulding, Rear				
2 Door	Upper	20481618		23.90
	Side	20481506-7		20.10
	Lower end	20291222-3		22.15
	w/ Full Vinyl Roof	20329001		25.50
# Paint to Match				
Coupe	Upper	20442309		23.90
	Side	20442314-3		22.15
	Lower	20442309		23.90
	Side R	20169581-2		18.55
4 Door	Upper	20146814-5		22.90
	Side	20146814-5		22.90
	Lower	20146814		22.90
	Side R	20146814		22.90
Moulding, Inside Garnish				
2 Door	Upper	20540414	3	22.65
	Lower	20540588	3	26.00
4 Door	Side R	20400068	3	12.40
	Side L	20540599	3	12.20
	Lower	20387047	3	26.00
# Paint to Match				

QUARTER PANEL Cont'd				
SHEET METAL				
				
1 Panel, Outer	R = 20807828	14.8	318.60	
	L = 20807837	14.8	318.60	
2 Extension, Rear	20495075-6	5	25.85	
3 Extension, to Comp. Pan	20173872-3	01.8	18.70	
# w/ Quarter Panel Removed				
4 Panel, Inner Upper	20173880-1		18.05	
5 Filler, at Quarter Window	20173518-7		24.85	
6 Gutter, Ctr Wind Drain	NA			
7 Panel, Inner Lower	20211842-3		4.65	
8 Panel, Wheelhouse	20211680-1		27.75	
9 Panel, Lock Lower	Outer 20173548-7	2.5	74.50	
	Inner 20038546-1		44.00	
	HSS	03.8		
# Exclud. w/ Quarter Panel Removed 3.0				
Panel, Pillar Upper				
10 Inner	exc 20337968-9		38.00	
	w/ Hatch Roof 20210718-9		45.30	
11 Outer	NA			
12 Extension, Upper Outer	NA			

AUTO BODY DIAGNOSING AND ANALYZING DAMAGE

BACK WINDOW

Glass, Back Window	Clear	20354210	#1.5	130.00
2 Door	NAGS	C 35741	#1.5	137.85
	Tinted	20354211	#1.5	142.00
	NAGS	T 85741	#1.5	140.05
	Heated	20354212	#1.7	260.00
	NAGS	T 85740	#1.5	133.00
4 Door Sedan	Clear	20146008	#1.5	135.00
	NAGS	C 36129	#1.5	137.00
	Tinted	20146009	#1.5	138.50
	NAGS	T 86129	#1.7	264.00
	Heated	20146010	#1.7	280.50
	NAGS	T 86129	#1.7	280.50

w/ Tucked Vinyl Top Add 3.5

Moulding, Rear	Upper	20481618	23.90
2 Door	Side <td>20481506-7 <td>20.10</td> </td>	20481506-7 <td>20.10</td>	20.10
	Lower exc <td>20291222-3 <td>22.15</td> </td>	20291222-3 <td>22.15</td>	22.15
	w/ Full Vinyl Roof <td>20325001 <td>25.50</td> </td>	20325001 <td>25.50</td>	25.50

Paint to Match

Coupe	Upper	20442308	23.90
	Side <td>20442314-3 <td>22.15</td> </td>	20442314-3 <td>22.15</td>	22.15
	Lower <td>20442309 <td>23.90</td> </td>	20442309 <td>23.90</td>	23.90
	Side <td>20146561-2 <td>18.55</td> </td>	20146561-2 <td>18.55</td>	18.55
4 Door	Upper <td>20146814-5 <td>22.90</td> </td>	20146814-5 <td>22.90</td>	22.90
	Lower <td>20146816 <td>22.90</td> </td>	20146816 <td>22.90</td>	22.90

Moulding, Inside Garages

2 Door	Upper	20540414	2	22.65
4 Door <th>Upper</th> <th>20540598</th> <th>2</th> <th>26.00</th>	Upper	20540598	2	26.00
	Side R	20400068	2	12.40
	L	20540599	2	12.20
	Lower	20387047	2	26.00

Paint to Match

QUARTER PANEL Cont'd

SHEET METAL

1 Panel, Outer	R = 20607936	14.0	318.60	
	L = 20607937	14.0	318.60	
2 Extension, Rear	20495075-6	2	23.85	
3 Extension, to Comp. Pan	20173872-3	#1.8	18.70	
# w/ Quarter Panel Removed				
Filler, Pan	20173880-1		16.05	
4 Panel, inner Upper	20173516-7		24.85	
5 Filler, of Quarter Window	NA			
6 Gutter, of Wind Drain	NA			
7 Stiffener, of Bolt	20211842-3		4.85	
8 Panel, inner Lower	20211680-1		27.75	
9 Panel, Wheelhouse	Outer	20173546-7	2.8	74.50
	Inner	20034540-1		44.00
10 Filler, Lock Lower	NSS		#5.6	
Included in Outer Panel				
# Except # w/ Quarter Panel Removed 2.0				
Panel, Filler Upper				
10 Inner	exc 20337966-2		36.00	
	w/ Match Root 20210718-9		45.50	
11 Outer	NA			
12 Extension, Upper Outer	NA			

Directions: Using the estimate below, answer the following questions.

SHEET 1 OF 1 SHEETS

NAME Lillian George DATE 9-4-87

ADDRESS 513 Sweet Mary, Ind. Mo PHONE 632 0100

INSURED BY Home Insurance Co. ADJUSTER Jack Jones PHONE 632 0101

BELOW IS OUR ESTIMATE TO REPAIR YOUR 1981 Ford LTD

MODEL 1981 Ford LICENSE MO 167 CAR VIN 167 CAR MILEAGE 23,742.9

PARTS NEEDED	LABOR HOURS	PARTS		LABOR COST ESTIMATE
		NUMBER	AMOUNT	
✓ Face bar guard	1.8	EQAZ17157A	167.85	36.00
✓ Pad-impact (center)	.3	EQAZ17C829A	13.60	6.00
✓ Pad-impact (outer)	.2	EQAZ17C835D	11.55	4.00
✓ Left fender, inner panel	1.5			30.00
✓ Left fender, outer panel	1.5			30.00
✓ Refinishing time	2.2		36.00	44.00
CUSTOMER PAYS \$100		TOTAL 229.00		150.00
INSURANCE CO. PAYS 292.74		WRECKER & TOWING		-
SIGNED <u>Lillian George</u>		TAX 6% 13.74		
AUTHORIZATION FOR REPAIRS You are hereby authorized to make the above specified repairs		TOTAL MAT. & →		242.74
SIGNED <u>Home Ins Co</u> DATE <u>9-4-87</u>		GRAND TOTAL		392.74

12. What part(s) will be repaired?

13. How many parts will be replaced?

DIAGNOSING AND ANALYZING DAMAGE

14. What is the total cost of the estimate?
15. What is the total cost of labor?
16. What part costs the most?
17. How many miles is on the vehicle?
18. Was there a tow fee?
19. How much will tax cost?
20. Who is the insurance adjuster?

DIAGNOSING AND ANALYZING DAMAGE

DIAGNOSING AND ANALYZING DAMAGE

PERFORMANCE CHECKLIST

Student _____ successfully performed the following tasks:

	YES	NO	COMMENTS
1. Defined four terms that apply to estimating costs and analyzing damage			
2. Used the zone system, as recommended by I-CAR, to analyze damage			
3. Read a damage report			
4. Identified parts of a damage report			

Satisfactory - should move on____

Should repeat this unit____

Student's Signature/Date

Instructor's Signature/Date

END

U.S. Dept. of Education

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ERIC

Date Filmed

March 29, 1991